FOOD FOR THOUGHT



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TO ALL WHO are seeking to attain wisdom; that it might be applied to personal development and aspirations and to nurturing a gracious relationship toward our fellowman and the planet we live upon.

Education is not that one knows more– But that one behaves differently.

John Ruskin

Men and women must be taught to take a careful review of every habit and practice and to put away those things that cause an unhealthy condition of the body and thus cast a dark shadow over the minds.

Ellen White

The body is the only medium through which the mind and soul are developed for the upbuilding of character.

Ellen White

Introduction

THIS BOOK IS not only about food, but is also a thoughtful evaluation of what governs our food choices. What is your unique template in choosing how you will be nourished? This is not a small or casual decision. It encompasses life and death consequences. It is food which sustains the complex interplay of mind, body, and soul. As science seeks to better understand the microscopic metabolic processes involved in how diseases develop, it is becoming clear that the kind of food we eat, especially fat, and particularly saturated animal fat, has impact not only upon such things as hormonal regulation and immunity, but also has the potential to damage our DNA. To alter DNA is to make an assault on the major control switch of every cell, which obviously would have critical and enormous repercussions, one of which may be the genetic legacy we pass to future generations. When we damage our own DNA and weaken our resistance to disease, how does that influence our children? I have often heard either fate or God blamed for disease and suffering. I listen and wonder; could it be that our own choices about how we care for our bodies play a much greater role in weakening our resistance to disease than we comprehend or care to admit?

As people today begin to understand better and more fully the importance of diet and its relationship to one's physical, mental, and spiritual health, the value of vegetarianism is coming into its prime as scientific research provides a plethora of information on the benefits to be gained from the plant world. Research on these benefits is not always conclusive because it takes time and repeated studies to prove direct relationships regarding how the body responds to specific food substances. One of the time consuming factors in carrying forward this research is having to isolate individual responses until piece by piece an entire mechanism is fully understood. This is complicated by the fact that body processes down to their smallest atoms of activity do not function in isolation, but rather as part of an intricate, interrelated synergistic system. However, as you examine the evidence, clear trends will emerge. There is no question that the way we eat affects our health. And by health I do not mean merely freedom from disease. Health implies a state of well-being which embraces all levels of our identity—physical, emotional, intellectual, and spiritual. There is an ever-increasing acknowledgment that our total well-being is anchored in a strong physical foundation. We often think of enhancing personal development in terms of deepening our understanding of personality or complexities of temperament, the pursuit of an intellectual challenge, artistic expression, building character, or in terms of some kind of spiritual growth. We completely overlook the fact that all of what we are has a physical inception, and that a healthy body sets the tone for all other endeavors. This means that the way we care for our physical body becomes the matrix for everything else. This concept is still not comprehended in its full scope. We have been dawdling a very long

time over the pros and cons until the advantages have now become almost overwhelming. Yet proponents of vegetarianism have been speaking to us for centuries, and without the insights of a wide array of scientific data. These bright, progressive minds had insight of another kind worthy of our attention. Listen to their voices.

> Think of the fierce energy concentrated in an acorn! You bury it in the ground, and it explodes into a giant oak! Bury a sheep, and nothing happens but decay! -George Bernard Shaw

> While we ourselves are the living graves of murdered beasts, how can we expect any ideal conditions on earth?
>
> -George Bernard Shaw

> The time will come when men such as I will look on the murder of animals as they now look on the murder of men.
>
> -Leonardo da Vinci

> People often say that humans have always eaten animals, as if this is a justification for continuing the practice. According to this logic, we should not try to prevent people from murdering other people, since this has also been done since the earliest of times. -Isaac Singer

> I have no doubt that it is part of the destiny of the human race in its gradual development to leave off the eating of animals, as surely as the savage tribes have left off eating each other when they came into contact with the more civilized.
>
> -Henry David Thoreau

Thoreau was once chided by a farmer for being a vegetarian. He responded by reminding the farmer that he spent all day walking behind his two oxen, who were vegetarians, and who did all the hard work for him.

> What more unpleasant sight to a reflective mind than the beasts slain to be devoured. -Ellen G. White

> What might not men and women have been had they realized that the treatment of the body has everything to do with the vigor and purity of mind and heart. -Ellen G. White

> And God said, Behold, I have given you every herb bearing seed, which is upon the face of all the earth, and every tree, in the which is the fruit of a tree yielding seed; to you it shall be for meat. -Genesis 1:29

These men and women were able to perceive the elevating implications and nuances stemming from the relationships among how we eat, how we care for ourselves, how we care for each other, and how we care for the planet we inhabit. As one philosopher so eloquently stated, we should see farther than those who have gone before us because we stand on the shoulders of giants.

There have been more than just a handful of inventors, writers, scientists, artists, and philosophers who were not only visionary in what they contributed to the culture of their day, but who were also ahead of their time in discovering the benefits of a vegetarian way of life. Might there be a connection? It's an interesting list:

Bronson Alcott and
Louisa May Alcott
Cesar Chavez
Charles Darwin
Thomas Edison
Mahatma Gandhi
Horace Greeley
John Milton
Scott Nearing
Ovid
Plutarch
Porphyry
Henry Salt
Seneca
Mary Wollstonecraft Shelley
and Percy Bysshe Shelley
Socrates
Leo Tolstoy
Voltaire
Ellen G. White

Clara Barton
Annie Besant
Leonardo da Vinci
Isadora Duncan
Albert Einstein
Sylvester Graham
John Harvey Kellogg
Malcolm Muggeridge
Sir Isaac Newton
Plato
Alexander Pope
Jean Jacques Rousseau
Albert Schweitzer
George Bernard Shaw
Upton Sinclair
Isaac Bashevis Singer
Henry David Thoreau
Peter Tosh
H. G. Wells
Esme Wynne-Tyson

(Source: Vegetarian Times, February 1994)

This book will focus on how to assess the life promoting and health protecting qualities of the foods we eat. It will examine what current research is conveying to us about staying healthy and the numerous ways in which plants are our benefactors. It is certainly not an exhaustive compilation, but rather moves glimpse by glimpse over topics basic to an understanding of how our bodies function and what is needed to keep them in optimal health. It will have a mild sprinkling of philosophical questions. I do hope it will awaken an awe toward our incredible body systems and the marvel of how these systems coalesce to create a whole which is vastly beyond the sum of its parts, and it will also capture in some small way the sublime interconnectedness which drives not

only internal processes, but serves to remind us that we draw our life from the bounties contained in nature’s hand.

1
Nature's Harmony

LET ME BEGIN with a short story about rabbits, passed on to me by Dr. M. G. Crane, a research physician at Weimar Institute in California. He was at a convention presenting data on how arteries to the backbone, hips, and knees seem to plug up before arteries to the heart and head. Afterward he was met by Dr. Merril, an orthopedic surgeon from the University of Utah, who concurred with his conclusions and decided to prove it by means of rabbit experiments.

He set out to have five groups of rabbits. These five groups would span a dietary range from totally vegetarian (a typical rabbit diet), to a totally animal flesh diet consisting mostly of raw hamburger. It took about a month for the rabbits to get to like raw hamburger, but once they did, they didn't like anything else. However, their dispositions became radically transformed. The rabbits on meat became vicious. "They would eat each other, eat their own offspring, and if the rabbit in the next cage got too close, they would get hold of an ear or foot and eat as much as they could. They even attacked the caretaker whenever he went in to feed them."***1**

Dr. Merril said he had to discontinue the experiment. He couldn't keep the rabbits alive long enough to find out if the arteries to the backbone plugged up or not. As he recounted the experience he expressed deep concern over what happens to rabbits on meat. He indicated that it took about a month for the rabbits to return to their vegetarian diet, but when they did, they once again regained their calm disposition.

While acknowledging that male rabbits can sometimes be hostile, and that there is room for debate regarding the virtues of experiments on animals, this study could launch discussion on a myriad of points to ponder— the most obvious being the dynamic between diet and behavior and the implication that the relationship between food, specifically dead animal flesh in this case, and aggression may be more profound than we even remotely realize. Spin-off implications could extend to encompass delinquency, crime, violence, and the etiology of how such social pathologies develop. While it may be true that food is not the major instigator of such behaviors, evidence seems to suggest it may indeed play a supporting role. *****

An interesting and innovative program for dealing with criminal behavior was developed by an Ohio probation officer, Barbara Reed, in the early 1970s. She decided to add a diet therapy program to the more mainstream approaches of psychological counseling to help keep her probationers, first and second time offenders, from committing another more serious crime and ending up in jail. Statistically, seven out of ten probationers (seventy percent) return to the court system on more serious charges and are sentenced to jail or prison.

Her probationers were placed on a strict diet which permitted no sugar, white flour products, chemical additives, caffeine, or alcohol, and which was

abundant in fresh fruit, vegetables, grains, with some lean chicken, veal, or fish, and plenty of water. In ten years' time, between the early 1970s and 1980s, eighty percent of those on her program, numbering more than five thousand men and women, transformed their lives to become productive members of society. That is more than double the typical thirty percent who are rehabilitated by more traditional methods. Her success was so remarkable that it became front page news in the *Wall Street Journal* in 1977, and subsequently Barbara Reed offered testimony before a Senate committee on Nutrition and Human Needs and a legislative committee in Los Angeles County, which eventually voted to remove all junk and processed food from Los Angeles Juvenile Correctional facilities.

Barbara Reed does not disregard the benefits of psychological counseling— but her personal experiences and observations have led her to conclude that trying to correct a person's misbehavior without attention to an adequate diet is similar to trying to drive a car without gasoline. Probationers themselves were impressed with the benefits. Their improved sense of energy, vitality, and serenity became linked to a positive attitude and commitment to stay out of trouble.***2**

*****I am told by rabbit breeders that cannibalistic behavior in rabbits is well known. That simply reinforces the point, that an unacceptable behavior natural to rabbits may rise to alarming levels simply as a result of changing the diet from all-vegetable to part- or all-flesh food.

It doesn't require much imagination to consider where a diet of fast food, alcohol, and other drugs could eventually lead. There is doubtless an array of factors at work in these two examples demonstrating the link between diet and behavior, and it would be simplistic to say that if we could put everyone on a specific kind of diet we could eliminate all of the world's woes; however, it would also be a mistake to overlook the significance of food in all that makes us what we are and influences what we do.

The first point to understand in making health-promoting dietary choices is that food is not just a matter of taste or individual preference, it is the matter or material of *life*.

FOOD CREATES CHEMISTRY.

Locked within food's molecules are not only the elements required to provide energy and maintain a sound physical structure, but this chemistry also mediates our thinking, emotions, moods, attitudes, stamina, and vigor; acts as protection from disease; and sets the tone for our entire state of well-being. The body is a composite of chemical interaction and electrical impulses. It's what happens at the level of cellular, molecular activity that is reflected in what you see, think, and feel— spanning the spectrum from physical appearance to overt behavior.

When we look into a mirror we see our physical structure. This level of awareness is but a superficial glimpse of body composition. We see lots of skin, but skin is not just our external wrapping, it is an immense network of cells constantly at work. The skin is the body's largest organ; it is our immune system's first barrier of defense. Ponder a moment the composition of a 3/4-inch square of skin on the back of your hand. It contains:

13 yards of nerves	75 pressure sensors
9 feet of blood vessels	36 heat sensors
9000 nerve endings	30 hairs
600 pain sensors	6 cold sensors
300 sweat glands	4 oil glands

Added to this is the fact that the skin you see today will be totally renewed in a matter of a few weeks.***3** The stomach, which spends long hours in digestion and secretes the most potent acid in the body, is in an almost constant state of renewal. The cells which line your stomach will be replaced within three days. That means a loss and replacement of a half-million cells per minute in order to accomplish the task in that three day interval.***4** We are composed of 75 to 100 trillion cells,***5** each one of these cells performing its functions to support life, each one nourished by the food we put into our mouths. These cells have individual and interrelated roles to perform. They make up our organs, muscles, bones, and teeth. Nothing is static. Growth, repair, maintenance, movement, sensory input, regulation and exchange, metabolism; all are dominated by a chemistry so incompletely detailed that as much as we understand about body function, it is still a seemingly endless frontier of discovery. I underscore chemistry because, just as a chemist creates compounds and mixtures with a specific end in mind, we occasionally need to be reminded that food creates chemistry which directs an optimal, suboptimal, or sometimes downright dismal outcome regarding our health and well-being.

Without getting lost in the labyrinth of chemical interaction, it is necessary at least to acknowledge that all that we are is driven by these complex reactions. Even RNA and DNA are fed by food choices. Our genetic code provides the milieu in which all of this chemical-electrical activity occurs, creating each of us a unique individual. For some this will mean more predisposing factors to certain diseases; others will be favored with a propensity to longevity; but regardless of this genetic birthright, we significantly contribute to the outcome by choosing to what extent we will endeavor to maintain our own optimal health. Diet, exercise, and our ability to cope with the stresses of living are the three most important factors in maintaining optimal health. Each of these three factors impinges upon the others in such a way that the whole is immeasurably greater than the sum of its parts.

Without laboring the point, diet, exercise, and stress or distress all affect body chemistry and we are once again led to examine the complex interactions among atoms, molecules, electrical impulses, fluids, and cells. It is through the insights gained by studying the chemistry of metabolism and other body processes that researchers contribute to our understanding of the factors involved in achieving optimal health.

In this book the focus is on food. Yet to reduce food intake to a chemical formula would also be incomplete, for eating was intended to be a pleasurable experience. Certainly the vast array of sumptuous tastes, colors, and textures which nature provides indicates that food was meant to appeal to our senses (common sense included), and that satisfying the body's requirements for nutrients should not have to come at the expense of pleasing flavor, aroma, visual appeal, and variety. This book is an attempt to widen the vista on our perspective of eating, to sense how something as seemingly simple as food creates complex repercussions upon how we look, think, and feel. The more we understand about the implications of food as it relates to health, well-being, and interaction with others, the more intelligently we can formulate our own rationale for why and what we choose to sustain us.

Food is intended to promote *life,* a concept which seems to elude many, as we observe the large numbers of people who inhabit broken down, sluggish bodies which are hard to get started, hard to keep going; and who are fortified by stimulants and depressants, and spend long years laboring under the burden of excesses which work to dim the glow of vitality through the passing of time and to diminish the exuberance of feeling fully alive.

A second key principle to understand is that our bodies do not function in a random fashion. That may be the way some choose to eat, but it is not how the body processes operate. An appreciation for this fact may lead us to give more thought to what goes into our mouths. There is nothing random about digestion and absorption; they are coordinated in every detail. Beginning with its central location in the body, the physical structure of the digestive system is ingeniously designed for its task.

The small intestine, the primary organ of absorption, is 22 feet of coiled length. With its folds and finger-like projections covering these folds, called villi and microvilli, it provides 250 square meters (2700 square feet) for the extremely complex process of absorption to take place.***6** Two intricate and sensitive systems coordinate all the digestive and absorption processes: the hormonal (endocrine) system and the nervous system. Contents of the GI tract either stimulate or inhibit digestive secretions by way of messages carried from one site to another via hormones and nerve pathways. It is an intricate feedback system so advanced we do not yet understand all of its complexities.

For instance, secretions from the pancreas contain a mixture of enzymes to digest carbohydrate, fat, and protein; but how does the pancreas know just how much of each to secrete, tailor-made specifically for the meals its owner is

eating? Or, it is known that digestion slows down when fats are eaten because fat takes longer to digest than carbohydrate; but how does the intestine know when to slow down?***7** Recent research cited in *Eating Well* magazine (March/April 95) may provide a clue to answering these questions. Researchers have uncovered a connection between the stomach and brain which is much more sophisticated than previously thought. This research discloses a vast network of nerves which suggests that the brain monitors and assesses every morsel of food through a complex network of stomach and intestinal sensors, as well as hormones and specialized peptides. Upon integrating all the messages, the brain decides whether to continue eating or wait for the next meal—all without a conscious thought on your part.

There seems to be some link to weight maintenance in this process. Researchers are continuing with this investigation. The more we learn, the more evident the brain-nervous system-stomach connection becomes. We need to consciously consider that we are feeding our brain with the food we eat. Everything is in some way related to the brain-nervous system connection. Our eating habits certainly cannot be dismissed as an insignificant factor in modulating this critical connection. To continue to explore how body chemistry influences the way we feel, let's take a brief look at the B vitamins.

Vitamins do not provide calories or yield energy as do carbohydrates, protein, and fat. And they are needed in very small quantities. The smallest quantity of B vitamin needed is vitamin B_{12}, a daily dose of which would amount to as little as the period at the end of this sentence.***8** Though little is needed, they are powerhouse performers. B vitamins are involved in the metabolic pathways whereby our food is broken down and transformed into usable energy. They don't provide energy themselves, but they make possible the release of energy from our food by acting as coenzymes or catalysts for chemical reactions. They facilitate the processes by which nutrients are digested, absorbed, or built into body structures. Metabolism simply could not function without them.***9** Every B vitamin is part of one or more coenzymes that make possible the body's chemical work, and a litany of ailments can occur when they are in short supply. As you will see in a later chapter, B vitamins are predominantly found in plant foods. The following display is a brief depiction of B vitamins' general responsibilities which accounts for less than 1/100th of what B vitamins actually do.***10**

Muscles and other tissues metabolize protein, utilizing
NAD, THF, PLP, B_{12}
Brain and other tissues metabolize carbohydrates, utilizing
THF, NAD, CoA, FAD, FMN, TPP, B_{12}
Bone tissues make new blood cells, utilizing
NAD, THF, PLP, B_{12}
Liver and other tissues metabolize fat, utilizing
THF, NADP, NAD, CoA, BIO, TPP, FAD, FMN, B_{12}

Digestive Tract lining replaces its cells, utilizing THF, NAD, PLP, B_{12}

COENZYME NAME	**VITAMIN NAME**
THF	Folate
NAD, NADP	Niacin
CoA	Pantothenic Acid
FAD, FMN	Riboflavin
TPP	Thiamine
PLP	Vitamin B_6
BIO	Biotin
B_{12}	Vitamin B_{12}

If we narrow our focus to the influence of B vitamins on brain chemistry, we begin to grasp the impact of how deficiencies can influence our mental state of being. Scientific methods for mapping brain function are based, once again, on chemistry. Brain mapping is revised almost daily as a result of new brain chemicals continually being discovered. The following list of mental effects of vitamin B deficiencies is based on what we presently know. Some symptoms are warnings of a developing problem, others are manifested when deficits are severe. This list is not intended for self-diagnosis, but rather to suggest that the expression, "you are what you eat" may hold true not only physically, but mentally, emotionally, and spiritually as well.

Thiamin deficiency causes confusion, uncoordinated movements, depressed appetite, irritability, insomnia, fatigue, personality changes, memory and cognition impairment, shortened attention span, impaired ability to work or learn, and depression.

Riboflavin deficiency causes depression, hysteria, psychopathic behavior, lethargy, and hypochondria evident before clinical deficiency is detected.

Niacin deficiency causes irritability, agitated depression, headaches, sleeplessness, memory loss, emotional instability, and mental confusion progressing to psychosis or delirium.

Vitamin 6 deficiency impairs neurotransmitter synthesis, causes irritability, insomnia, weakness, depression, abnormal brainwave patterns, convulsions, the mental symptoms of anemia (described below), fatigue, and headaches.

Folate deficiency * causes the mental symptoms of anemia (described below), tiredness, apathy, weakness, forgetfulness, mild depression, abnormal nerve function, irritability, headache, disorientation, confusion, and inability to perform simple calculations.

Vitamin B_{12} deficiency causes degeneration of the peripheral nervous system, anemia, and neuropsychiatric damage.

The mental symptoms of **iron deficiency anemia** mentioned in vitamin 6 and folate deficits include apathy, listlessness, behavior disturbances, clumsiness, hyperactivity, irritability, lack of appetite, learning disorders (vocabulary, perception), lowered IQ, reduced physical work capacity, repetitive hand and foot movements, and shortened attention span. These symptoms arise in the brain due to iron deficiency anemia.***11**

Let's conclude our glance at the B vitamins by narrowing the focus once more to a single B vitamin, thiamin (B_1).

*****Vitamins are not always one specific chemical; sometimes any of a group of chemicals which share a particular structure may accomplish the vitamin function.

In his *Model of Living* Series, Gary Strunk, health educator and consultant, cites a study conducted by doctors at the Mayo clinic over fifty years ago. For the six-month duration of the study, the women participants were to live in an institutional setting where their daily food intake could be controlled. They were placed on a diet which was considered adequate for every nutrient except one—it lacked thiamin or vitamin B_1. The women chosen for this study were especially selected because they were known for their cooperative attitude. Within ten days on this diet, their behavior began to change. They became nervous, irritable, fidgety, and on-edge. They were no longer cooperative, nor could they get along with one another. In fact, they became so agitated they refused to do something as simple as to make their beds. The experiment had to be cut short because these normally cooperative and mature women had become extremely contrary and obstinate. Remarkable were their own comments about wanting to be more cooperative but somehow at the same time being unable to override their disagreeable spirit.***12**

How easily and imperceptibly we may undermine our own best intentions by our eating habits! We routinely acknowledge the impact of environmental factors on individual development. We accept without question that children who come from negative environments in which parents have been absent, negligent, or abusive must cope with the emotional scars and baggage that have resulted. The emotional legacy left to these children will often follow them for life. Is it too radical to suggest that food is also an environmental factor which has long term consequences influencing not only our day by day disposition but which also may eventually lead to our own untimely death by perpetual abuse of our own body system? What kind of health legacy are we bequeathing to our children, and in turn passing on from one generation to the next? Have we any heirloom more priceless than health?

At one time I worked as a health educator for a nutrition program targeting pregnant women, infants, and children under five years of age. This was a

government program in which food supplement coupons were provided to ensure adequate intake of iron, calcium, and vitamin C. In order to be eligible for the program, the pregnant or lactating woman, or her child, had to have a form filled out by a physician indicating that she or her child had a medical risk factor related to a dietary inadequacy. Two examples of such factors could be low birthweight or being below the normal growth curve for children at a given age. Another typical risk factor for those we enrolled was iron deficiency anemia (see mental symptoms at end of list of B vitamin deficiencies, p. 16). This is a specific kind of anemia, caused by lack of iron in the diet, not to be confused with anemia's which develop from other causes. Iron is commonly found in almost all foods except dairy products. So if one eats a balanced diet with an ample variety of foods, it is generally unlikely that iron deficiency anemia would develop. This program also included periodic nutrition counseling with participants in which a dietary assessment and options for eliminating their particular risk factors were discussed.

An experience that stands out in my mind was a time when I was going over the dietary intake forms with a woman who had two small children enrolled on the program because they had iron deficiency anemia. We were going over iron rich foods that she could add to her children's diet when she suddenly became aware that iron deficiency was related to how one ate and was not a genetically inherited disease. She looked at me in amazement as she expressed that her grandmother had iron deficiency anemia, as did her mother, she herself, and now her two children. Somehow, in spite of the many encounters she and her extended family had had with health care providers, she had never understood that this kind of anemia was not being transmitted in the genetic code but was a nutritional legacy being passed from one generation to the next by means of their inherited eating habits. The cycle could be broken.

In this overview we have opened the window on three key concepts: food creates chemistry, the body does not function randomly, and the best food choices are those which promote *life*. These themes will continue to be woven throughout the following chapters. We sometimes speak of our being as though it were composed of separate compartments as a way of defining responses within a given scope—physical, mental, emotional, and spiritual. In truth, everything about our being is interrelated, and these first few pages have touched only briefly on ways in which this is true. Our brain, citadel of intelligence, emotion, creativity, our very mind, and soul, is marvelously mediated by chemistry and electrical impulse, instigated by how we nourish and care for our bodies. It may be that there is no greater impact we can make on our future, our happiness, and the welfare of others than the choices we make regarding our health. In biblical times admonition was given to care for one's body as a temple, a structure of not only the most exquisite physical workmanship, but one also held in deepest reverence and respect. Perhaps the wisdom in this metaphor is worth preserving.

2
Nature's Life Force

IN THIS SECTION we will begin to examine the six nutrients essential for life. These vital nutrients are carbohydrate, protein, fat, vitamins, minerals, and water. It is important to make a distinction between essential nutrients and an essential food. An essential food really doesn't exist. There are numerous foods which promote life and are conducive to health, but there isn't any single food that one absolutely must eat to attain optimal body function. However, it is imperative that food choices supply these six essential nutrients. It will become evident as we examine these six essentials that certain foods rank much higher than others in supplying our nutrient needs. Before delving into these nutrients, it would be well to have a framework on which to construct the principles of making wise food choices. This can be built on two supporting pillars: nutrient density and balance.

Nutrient density means getting the most nutritional value from the calories you take in. Carbohydrates, such as fruit, vegetables, grains, and legumes, generally provide the widest range of nutrients for the least calories. They are rich in vitamins, minerals, fiber, provide some protein and almost no fat. It's like applying the concept of getting the most for your money to food choices.

Balance, the other pillar, is a key concept when it comes to body function, since all body processes seek to achieve this end. In a dietary sense it embraces variety, adequacy, and moderation. To routinely choose the same limited spectrum of foods could lead to dietary inadequacies and would not deliver the benefits to be gained from a wide variety of foods, especially where vitamins, minerals and other protective plant chemicals are concerned. A narrow range of food selection also jeopardizes the delicate balance of all nutrients working together in proper amounts so vital to optimal health.

Excess also creates imbalance and is just as conducive to improper balance and poor health as getting too little. Generally we think in terms of avoiding that which is harmful, but we must also consider that there may be negative consequences in getting too much of even a good thing.

As previously mentioned, body nutrient requirements and processes are not random. I reiterate this concept because some people seem to amble quite randomly through the process of food selection. They eat to satisfy a craving, urge, or impulse with little forethought. I'm not saying one must rule out spontaneity or an occasional splurge, but for optimal body performance one must have some awareness of key nutrients and a method, or at least a notion, of how these nutrient needs will be satisfied. Another point, perhaps more subtle, is that there is a difference between eating what's required to survive and eating to maximize our health and well-being potential.

As we study these nutrients one by one, it will always be with an eye toward health enhancement. We will begin with the energy-contributing nutrients:

carbohydrate, fat, and protein. As a lead into our focus on carbohydrate, let's create a backdrop to explore the marvel of where this food energy comes from and how that is related to the essence of what makes food life sustaining. The sun will be the focal point in our backdrop, for without sunlight all life would cease to exist. We are solar-powered creatures of light, sustained moment to moment by the radiant energy of this magnificent star.

Have you ever given much thought to light? It is something of a conundrum to science because it possesses properties of both waves and particles, which is unlike anything else we know. Without light you could not be reading right now. The brain devotes a full thirty percent of its activity to vision. Four elements comprise the sense of sight: form, motion, color, and depth. Four separate areas of the brain are associated with these elements. Yet 1+1+1+1 does not equal 4 in this case, because it is still a mystery how these four factors come together in the brain to make sense out of what we see and actually create vision. It is not understood what integrates these elements to formulate sight. We do know that it is light originating from the sun which acts upon the eye to make the whole process possible.

Now let's challenge the mind's eye to explore the prism of meaning emanating from the relationship which inextricably links us to the sun's energy bound up in the food we eat. It is the plant world which captures this life-giving energy from the sun, and by the process of photosynthesis converts it into just the nutrients humans and all living organisms need to sustain life. If the eyes of our understanding could be enlightened, we might begin to see just how remarkable, unique, and compelling this relationship is.

The body requires six kinds of nutrients: water, carbohydrate, protein, fat, vitamins, and minerals. Most of these are composed of just four simple elements: hydrogen, oxygen, carbon, and nitrogen. Hydrogen plus oxygen makes water. Hydrogen, oxygen, and carbon combine to make carbohydrate and fat; protein contains nitrogen as well. It is an eloquently simple arrangement, and at the same time astounding in its capacity for variations on a theme. Through the process of photosynthesis, green plants intercept a portion of the sunlight reaching their leaves and capture its energy within the chemical bonds of glucose—a simple carbohydrate. Protein, fats, and other carbohydrates are then synthesized from glucose to meet the needs of the plant. The plant thus becomes a depository for all three of the energy providing nutrients—carbohydrate, fat and protein. Plants are also nature's storehouse for vitamins, minerals, fiber, and other chemicals which protect us from disease. Thus the plant becomes capable of providing all of our nutrient requirements.***13**

In this way we are able to harvest sunlight in the foods which we eat. Energy from the sun drives this process and thereby provides energy to us as the metabolism of our food breaks down these nutrients and releases the life locked within their molecular structures. The process of photosynthesis, centered on sunlight, is also an intrigue to science. Scientists know its reactions in the

minutest detail, and yet it has never been reproduced from scratch; only green plants can make it happen.***14**

The interdependent relationship between plant and man is so indispensable that we literally could not breathe without one an-other. We rely on the oxygen plants release, and they rely on our carbon dioxide. When one considers how primary breath and energy are to life, it gives one pause to consider whether this perpetual exchange between man and plant is merely a coincidental symbiosis or whether there may be something more profound at work: a meaningful design by which humans were intended not only to survive, but to be nourished in a way which would protect from disease, promote vitality, and enhance every dimension of our well-being. This is a philosophical question, I know. And it might be argued that eating has nothing to do with philosophy. On that point I must differ. After all, when people communicate their beliefs and values, are they not expressing their philosophy on *life?* And doesn't food have everything to do with *life?* Isn't that why we eat? Can there be a more intimate relationship than that which exists between our physical, emotional, intellectual, and spiritual well-being and the food which keeps us living, thinking, feeling, and creating, and which sustains all facets of those factors which make each one unique? Perhaps this is all so elementary that it is taken for granted and overlooked. But I would submit that the way we eat conveys a great deal about how we see the world, our responsibilities, and our place in the scheme of things. Consciously or not, the way we eat is connected to a myriad of other beliefs and perceptions.

As we continue our exploration into the benefits of the plant world, think of what *life* means to you. Webster's dictionary defines it as "that property of plants and animals which makes it possible for them to take in food, get energy from it, grow, adapt themselves to their surroundings, and reproduce their kind: it is the quality that distinguishes a living animal or plant from inorganic matter or a dead organism." Ponder Webster's definition in light of the logic of obtaining food to support *life* from the lifeless blood and flesh of a dead animal carcass whose body has become a second-hand, indirect, diminished source of the plants that you could have eaten directly, intact with their full complement of vital nutrients from living trees, vines, and nature's harvest. Doesn't that intimate at least an unnecessary waste, ineffectiveness, and perversion of what would seem a more ideal way to care for ourselves? I know the argument can be made that man sits atop the food chain and anything beneath him is fair game for consumption. Perhaps there is something that makes us feel powerful, even omnipotent, in that point of view. It is not for me to draw conclusions for anyone else, but to encourage thought as we supplement our personal perspectives and health goals with what we can learn from the growing body of research and observation regarding the way our bodies respond to the kinds of food we put into them.

CARBOHYDRATE—CAPTURING THE SUN'S ENERGY

Foremost among the six essential nutrients is water. Since it is constantly being lost, it must continually be replaced. Water is nature's beverage of choice. We will look at its importance separately in a later chapter. Carbohydrate, protein, and fat are the energy yielding nutrients. They are what provide calories in terms of the chemical action which releases heat energy when our food is broken down. In the body's normal resting (not sleeping) state, half of the energy expended is used in meeting the metabolic requirements of the nervous system. Twenty-seven percent is used by the liver, much of which is involved in providing fuel for the brain.***15** The brain and nervous system are fueled primarily by glucose derived from carbohydrate. Vitamins and minerals provide no energy to the body directly, but they serve as regulators in all body processes and as such become necessary for the release of energy from food.

Next to water, carbohydrate is the nutrient needed in the greatest quantity. Nutritionists and researchers advocate the virtues of a high carbohydrate diet. It is the preferred fuel for most body functions and is involved in all of the body's cells. It is ideal to meet the body's energy needs, feed the brain and nervous system, keep the digestive system fit, and to keep the body lean. That makes sense, since it is carbohydrate which contains the sun's radiant energy captured by plants in the form of glucose. How could carbohydrate-rich plant food not help to pass the sun's life-sustaining capacity on to us, when nature has used plants as a storehouse for this vital force? As you read this page, billions of glucose molecules are splitting each second to provide the energy which enables you to learn. A marathon runner also must thank the glycogen (the body's storage form of glucose) in his muscles that delivered the power to finish the race. Carbohydrates are the body's premium fuel, and plants are its major purveyor. Nutritionists advise us to emphasize complex carbohydrates in our diet.

Complex carbohydrates are long chains of glucose or sugar units in the plant. These chains may link hundreds of glucose units to form a starch molecule. These molecules, packed side by side in the rice grain or potato, may be as many as a million per cubic inch of food.***16** Metabolism of our food breaks the bonds linking these units together and heat energy is released. Starch is simply the way the plant stores glucose. Sometimes people malign starchy foods as being fattening. That is a myth. In general we need to eat more starchy foods, not less. All starchy foods are plant foods, and grains are the richest food source of starch. Most of the world's people depend on grain, such as rice, wheat, corn, rye, barley, or oats as a staple for food energy.***17**

Another benefit from the plant world is fiber, sometimes called roughage. Fibers make up the plant's supporting structures, such as leaves, stems, and seeds. The bonds that hold the sugar units together in these structures cannot be broken by human digestive enzymes; therefore, they pass through our bodies mostly unchanged and provide only negligible calories or energy. But they do

make a valuable contribution to our health. Here's a list of what fiber can do for you:***18**

Weight control. Fibrous foods contribute little energy and promote a feeling of fullness as they absorb water. A diet high in fiber-rich foods can promote weight loss if those foods displace concentrated fats and sweets.

Constipation, hemorrhoids, and diarrhea. Fibers that attract water into the digestive tract soften stools and relieve constipation and hemorrhoids. Other fibers help to solidify watery stools.

Appendicitis. Fiber keeps the contents of the intestinal tract moving easily, which helps prevent bacterial infection.

Diverticulosis. Fiber stimulates the muscles of the digestive tract so that they retain their health and tone; this prevents the muscles from becoming weak and bulging out in places, as they do in diverticulosis.

Colon cancer. Fiber speeds up the passage of food materials through the digestive tract, thus helping to prevent exposure of the tissue to cancer-causing agents in food.

Heart disease. Some fibers bind cholesterol compounds and carry them out of the body with the feces, thus lowering the body's cholesterol concentration and possibly the risk of heart disease.

Diabetes. Some fibers improve the body's handling of glucose, perhaps by slowing down the digestion or absorption of carbohydrate.

Do you know of any pill that can deliver such benefits? How ever, as good as fiber is, remember the balance concept. Most Americans eat too little fiber; but it is possible, if one became fiber obsessed, to get too much. In this case essential vitamins and minerals are bound and excreted without ever being available for the body to use. Even as an apple is different from a grain of wheat, so is the type of fiber they contain. The following list summarizes some of the differences.

Water-soluble Fiber. Primarily pectins. These could play a role in heart disease, diabetes, and weight control as described above. These slow the transit of food through the upper digestive tract. **Good sources:** Barley, fruits, legumes, oats and oat bran, rye, seeds, and vegetables.

Water-insoluble Fiber. Primarily cellulose and hemicellulose. These could play a role in colon cancer, diverticulosis, appendicitis, regulation of bowel movements, and weight control as described above. They speed transit time

through the colon. **Good sources:** Brown rice, fruits, legumes, seeds, vegetables, wheat bran, and whole grains such as wheat.***19**

You can see that several foods contain both kinds of fiber. The best way to maximize fiber benefits is to eat a wide variety of plant foods. The World Health Organization recommends these guidelines for carbohydrate and fiber intake:

50—75 percent of total calories should come from complex carbohydrates,
0—10 percent of total calories from refined sugars.
27—40 grams of dietary fiber daily.

The new food pyramid, which has replaced the four-food-group method for meeting nutrient requirements, suggests that to meet these recommendations we will need to choose five to nine servings daily from fruit and vegetables (with more emphasis on vegetables) and increase our intake of grains and legumes to six to eleven servings per day. Dietary guidelines are included in a later chapter. Fiber should also be obtained by eating a wide variety of fruit, vegetables, grains, and legumes rather than by intake of fiber concentrates. The following list may assist you in evaluating the fiber in your diet.

FIBER CONTENT OF SOME FOODS*20

Legumes:	About 8 grams per serving.		
Serving size:	1/2 to 1 cup.		
Baked beans,	1/2 cup;	Kidney beans,	1/2 cup;
Navy beans,	1/2 cup;	Lima beans,	1 cup;
Pinto beans,	1/2 cup;	Lentils,	1 cup;
Black beans	1/2 cup;	Garbanzo beans,	1 cup.
Grains and Cereals:	About 2 to 4 grams per serving.		
Serving size:	1/2 to 1 cup.		
Rye bread,	1 slice;	Whole wheat bread,	1 slice;
Bulgur,	1/2 cup;	Barley,	1/2 cup;
Oatmeal,	1/2 cup;	Wheat bran,	1/4 cup;
Dry cereal, such as Grape-Nuts, Shredded Wheat, Granola, All-Bran, or Raisin Bran, 1/2 cup.			
Vegetables:	About 2 to 4 grams per serving.		
Serving size:	as indicated.		
Artichoke,	1;	Corn on the cob,	2” piece;
Asparagus,	1/2 cup;	Eggplant cooked,	1/2 cup;
Beets,	1/2 cup;	Broccoli,	1/2 stalk;
Green peas,	1/2 cup;	Brussels sprouts,	1/2 cup;
Lettuce,	2 cups;	Green beans,	1 cup;
Cabbage,	1 cup;	Potato	1 small;
Carrots,	1 cup;	Pumpkin,	1 cup;
Cauliflower,	1 cup;	Spinach,	1 cup;
Celery,	1 cup;	Squash,	1 cup;
Collards,	1 cup;	Tomato,	1 medium.
Fruits:	About 2 to 4 grams per serving.		
Serving size:	as indicated.		
Apple,	1 small;	Kiwi,	1;
Apricots,	3;	Mango,	1/2 fruit;
Banana,	1 small;	Orange,	1 small;
Peach,	1 med.;	Pear,	1/2 small;
Cantaloupe,	1/2;	Pineapple,	1 cup;
Cherries,	20 to 30 cherries;	Grapes,	20 to 30 grapes;
Plums,	2 small;	Dates,	5;
Prunes,	2;	Figs,	2;
Blackberries,	1/2 cup;	Blueberries,	1/2 cup;
Raspberries,	1/2 cup;	Strawberries,	1/2 cup.

Can one eat too much carbohydrate? It is hard to eat an excess of complex carbohydrates because they are such a prized source of energy. What isn’t used

generally gets stored as glycogen in the liver and muscles, as reserve fuel. This glycogen reserve is not cumulative; it is utilized and restored daily. If one is active, the reserve can be depleted after one strenuous exercise session. However, if carbohydrate intake exceeds the body's need for energy and reserve stores, then the excess will be stored as fat. This most often happens when an individual eats sugary sweets which also tend to contain fat. Table sugar is a carbohydrate, but it is not complex. The starch and fiber in the sugar beet or cane have been removed and calories steeply concentrated during the refining process. Fruit also contains the simple sugars fructose and sucrose (table sugar), as do some vegetables and grains.

It may seem unfair to point a finger at refined sugar as leading to excess carbohydrate intake, and not to apply the same concern regarding these foods. The difference is in nutrient density. These foods are packaged differently. Along with the sugar comes vitamins, minerals, fiber, and plenty of water, all of which have been removed from table sugar during refining.

One must beware of refining as a rule, and particularly when it comes to grains. Most people are aware of that, but manufacturers' labels are sometimes misleading. When a product is enriched, certain key nutrients have been added back, but many more are not, such as magnesium, zinc, folate, vitamin B_6, vitamin E, and chromium. The significance of these minor minerals on optimal health is still not fully understood. And to determine that you are actually getting a whole wheat product, the label must say whole grain or stone-ground wheat. If it merely says wheat flour, that encompasses any flour made from wheat, including white flour. Whole wheat flour is a recombination of some thirty fractions of wheat, but represents only seventy percent of the original grain.

One final word about these compelling high complex carbohydrate plant foods. They are also a treasure house of vitamins and minerals. We will examine their remarkable protective characteristics in the next section. Nature made it elegantly convenient for us to meet energy and nutrient needs, while at the same time protecting us from disease, when it gifted us with the almost endless, delightful array of plant packages, beautiful to look at, succulent to taste, and filled with the promise of life.

FAT—VITAL, YES; BUT LESS IS ENOUGH

Fat is another key ingredient for health. Lipids is the more comprehensive term applied to include triglycerides, sterols like cholesterol, and phospholipids. Most of what we hear about these fats is negative because it is so easy to eat an excess, thereby crowding out more nutrient-dense foods and seriously distorting the balance of body systems and nutrient elements. Fat supplies nine calories per gram, which is more than double the four calories per gram which comes from carbohydrate and protein. That is why a little goes a long way. Too much fat is implicated in a number of diseases ranging from heart disease to a variety of cancers. Most people are concerned about too much fat because of its effect on

their appearance. However, being overweight has more critical implications than our looks. It contributes to heart disease, high blood pressure, diabetes, and osteoarthritis.

Lipids are the secondary energy source for the body; they are the best source of stored or reserve fat. As previously mentioned, the body stores some carbohydrate in the form of glycogen, but not for the long term. Fat cells can retain their stores indefinitely and have a great capacity for expansion, much to the chagrin of dieters. That does not mean that fat cells remain static, because everything about cellular activity is in constant motion. It's just that stored fat waits in storage until it is needed, and if there is an excess, it can wait a very long time. Triglycerides are the dominant lipid in both food and the body. That is the kind of fat people are talking about when they say, "I'm too fat."

Triglycerides can be made of saturated or unsaturated fat; in fact more than ninety-five percent of the fat we take in is in the form of triglycerides. That is also the body's stored form of fat and is composed primarily of fatty acids. It gets its name because it is made up of three (tri) fatty acids attached to a glycerol backbone (a small compound related to carbohydrates). Fatty acids have important roles to perform in terms of fat transport and metabolism, immune function, and maintaining the function and integrity of cell membranes.***21** Adipose (fat) tissue helps to hold the body organs and nerves in position and protects against traumatic injury and shock. The layer of fat beneath the skin serves to maintain body temperature. Fats aid in the absorption and transport of the fat-soluble vitamins, A, D, E, and K, as well.***22**

While cholesterol is a type of lipid, it differs from triglyceride. It looks like a wax and is not the same as the saturated fat with which it is often associated. It has its own identity. All of the lipids are defined by their chemical configuration, and this difference in their molecular arrangement makes a big difference in how the body responds to them. There is no escape from chemistry. Cholesterol is a specialized substance made in the livers of all animals. That's why animal liver is high in cholesterol. Among its various functions is its use as the raw material to make hormones and cell membranes. It serves a vitally essential role, but it is not needed as a part of our food intake. ***23 *24**

Your liver is manufacturing it now, as you read, at the rate of about 50,000,000,000,000,000 molecules per second.***25** The raw material the liver uses to make cholesterol can be derived from carbohydrate, protein, or fat. Animal products, meat, dairy products, eggs, and fish are the only way you can get cholesterol in your food. The plant world contains none. By now everyone is aware of the connection between cholesterol and atherosclerosis or heart disease. Even if one is skeptical of the so-called "facts" that somehow are subject to change as researchers piece together more of the mechanisms that drive the disease process in the body, the implications of increased cholesterol levels associated with increased risk of plaque build-up and heart attack have remained consistent over the past few decades of research. It doesn't take much

stretch of the imagination to visualize that waxy, greasy substances which we must scrub from our dishes by means of a detergent would be likely candidates to adhere to artery walls.

The build-up of these deposits forms plaques that narrow the openings in the coronary arteries which supply blood to the heart. These coronary arteries are so named because they circle the heart like a crown. It would be well to care for them as one would a jeweled crown of gold, for your life depends upon their preservation. In the U.S. someone dies of a heart attack every forty-five seconds.***26** The most advanced medical knowledge in history is telling us that heart attack and stroke victims, fifty percent of us, perish from a disease nurtured at our own hands.***27** Saturated fat and cholesterol are often spoken of together because they travel together in the same foods: meat, fish, dairy products, and eggs. There is a relationship between the intake of cholesterol in our food and an increase of cholesterol in our blood. It is also true that the more saturated fat you eat, the higher your cholesterol level. In fact, saturated fat raises blood cholesterol to an even greater extent than dietary cholesterol.***28** It is suggested that the most important dietary step we can take to lower risk for coronary artery disease is to reduce the intake of saturated fat. So to eat foods which contain both saturated fat and its companion cholesterol would seem more like tempting the grim reaper than eating to promote life. One of the reasons fat in the diet raises cholesterol in the body is that since fat is not water soluble, it needs an emulsifier in order for it to be digested, absorbed, and transported through body fluids and across cell membranes. One of these emulsifiers is called bile; it is made from cholesterol by the liver. Thus the more fat eaten, especially saturated fat, the more bile must be made in order for it to be digested, which means the liver must produce more cholesterol to make more bile, which in turn elevates the cholesterol in your blood.

HDL and LDL cholesterol must also be included in our understanding of how cholesterol influences body function. When cholesterol is transported in the bloodstream to be delivered to various parts of the body, it is packaged into special containers called low-density lipoproteins—(LDL). Cholesterol makes up half of LDL's composition. It has been labeled bad cholesterol because high levels of it in the blood dramatically increase the risk of heart attack. High-density lipoprotein (HDL) is composed half of protein, and rather than being in the cholesterol delivery business, it is used to dispose of cholesterol as it is released from dead cells. It is labeled good cholesterol because the more you have, the lower your risk for heart attack. High and low density have to do with the size and weight of the packages. Smoking and obesity lower HDL, vigorous exercise and foods rich in vitamin C can raise it.***29**

When you have a cholesterol blood test done, it generally includes an evaluation of total cholesterol, HDL, LDL, and triglycerides. Doctors may look for a ratio of total cholesterol to HDL of 3 to 1 as an ideal. The average American male ratio is 5.1 to 1. A recent study showed that Boston Marathon

runners have an average of 3.5 to 1. Vegetarians do the best, averaging about 2.9 to 1.***30** The current trend in evaluating LDL and HDL is moving away from emphasis on the ratio and instead assessing them as independent risk factors. If HDL falls within a certain range it is considered protective against heart disease and if it is below that range it is considered to be a risk factor for heart disease. Similarly, for LDL there is a normal range, above which there is risk. Although we refer to HDL as good and LDL as bad, both perform necessary roles in the body. LDL is deemed bad only when there is too much of it.

The recommended cholesterol goal has been arbitrarily set at 200 mg/dl by the National Cholesterol Education Program. Unfortunately this value may lull one into a false sense of security. The Framingham Heart Study, which for the past four decades has been evaluating who gets heart attacks and who doesn't, has shown that the ideal level would be below 150 mg/dl. Dr. William Castelli, director of the study, observed that in thirty-five years there hasn't been a single heart attack in anyone with a cholesterol under 150. We know that setting 200 as a recommended goal is inadequate because 205 is the U.S. average, and in a country where half of the people die of heart disease, that can hardly be the standard to aim for. That means a value of 180 or 190 cannot be shrugged off as nothing to worry about.***31** Generally speaking, the "average" is a suspicious standard of comparison. From what we know, the average individual is an individual at risk.

As already mentioned, dietary fats are referred to as saturated or unsaturated. The saturated fats are the more life-threatening of the two in terms of heart disease and certain cancers. All fats are a combination of saturated and unsaturated, but those which are highly saturated come from animal products. Tropical oils are the only exception. Coconut, palm, and palm kernel oil come from plants, but are mostly saturated. The unsaturated fats come from predominantly vegetable sources and from some fish. Potential problems with fish will be addressed in a later section.

Unsaturated fats are referred to as polyunsaturated or monounsaturated. The degree of saturation has to do with the chemical structure and whether the fat will be solid or liquid at room temperature. Saturated fat is solid at room temperature, unsaturated fats are liquid. Chemically, saturation relates to the hydrogen component of the molecular configuration. If all the hydrogen positions are full on the fatty acid chain, it is termed a saturated fat. A polyunsaturated fat has more than one place where a hydrogen pair could attach to the fatty acid chain, a monounsaturate has one position available for a hydrogen pair. As you can guess, the chemical structure of these fats plays a key role in how the body handles them.

The unsaturated fats from plants are considered safer than saturated fats, but that does not make them problem-free. The process of removing oil from a plant to form a product like vegetable cooking oil, salad oil, or margarine, dramatically concentrates the oil and alters the way it proportionately occurred

in the plant. We add an ounce of oil to a recipe and consider it to be an almost insignificant amount. But we would need to eat thirty medium ears of corn to get that much fat from nature itself, and in the processing we have eliminated all the vitamins, minerals, protein, starch, and fiber that come packaged in those ears of corn.

And then there are hydrogenated fats or trans fats as they are often called. These use a man-made process to add hydrogen to soybean, corn, and other liquid polyunsaturated oils to make them more solid, stable and thereby more marketable in terms of food texture and shelf-life. (You will recall it was the polyunsaturated oils that had room for more hydrogen to be added to their structure.) Hydrogenation transforms many of an oil's unsaturated fatty acids, making them become more saturated as those hydrogen positions are filled. Researchers are still studying the impact of these altered "transformed" fats, but at present it would seem they hold an ill foreboding.

The University of California at Berkeley Weilness Letter, September 1993, reported a Harvard study indicating that women who ate lots of food high in trans fatty acids, especially margarine, had a fifty percent higher risk of coronary artery disease than women who ate these fats rarely. Another study showed that people with coronary artery disease have significantly elevated levels of trans fatty acids in their blood. "Diet" margarines are generally lower in trans fat than stick varieties, but margarine is certainly not the only culprit. Nor does this mean butter is a better choice than margarine. But you must read labels to determine the very low fat spreads. Look for one with a liquid vegetable oil listed first rather than a hydrogenated oil. If you are a reader of food labels, you are already aware that hydrogenated oils are added to a vast array of foods.

Saturated animal fat is repeatedly implicated in the disease process, but while vegetable oils may offer some advantages, I must reiterate that they are far from harmless. It is true that cholesterol in the blood stream may drop using vegetable oils, but some studies indicate that cholesterol may simply be redistributed into tissues and arteries, which in turn can lead to hardening of the arteries or arteriosclerosis. A high-fat diet of any kind can produce agglutination—a condition in which our red blood cells tend to stick or clump together. That has several important implications, as demonstrated in research done on hamsters fed a high-fat diet by Dr. R. L. Swank of the University of Oregon (Proceedings of the Society of Experimental and Biological Medicine 82:381, 1953). He was actually able to see, by means of a microscope, this clumping together of cells in the thin walls of the hamster cheek pouch. This agglutination inhibits oxygen access through our capillary system and diminishes oxygen supply to our cells and tissues. In fact, when he hooked electrodes to the heads of the hamsters to determine oxygen content of the brain, he discovered that after a high-fat meal, the hamsters had a 62 percent decrease in the amount of oxygen available to their brains. Obviously, that would influence our mental acuity, would influence our emotional state, and would

contribute to the sense of sluggishness which often accompanies a high-fat meal. High-fat diets are implicated in chest pain because of oxygen deprivation to the tissues of the heart. Oxygen deprivation may also be implicated in the development of cancerous cells.

Otto Warburg, who won the Nobel Prize in 1931 for his discovery of the oxygen-transferring enzyme of cell respiration, discovered he could turn healthy cells into sick cells by means of oxygen deprivation (Science, 123:309—314, 1956). The sick cells would change their structure to exhibit malignant characteristics, and he found that he could produce these malignant characteristics in as little as forty-eight hours by depriving cells of sufficient oxygen. It is generally not in our conscious awareness, but we consume more oxygen than any other element. An ample, fresh supply of oxygen is vital to optimal health. Past studies have indicated that athletes have lower cancer rates than the average American. That is attributed to the increase of oxygen intake which is part of physical activity.

We must be cautious about the use of all fats. Our most healthful choice would be to prepare food free from grease of any kind. The closer food is to its natural state, the more life protection it contains.

Saturated fats from animal sources stimulate the liver to make more cholesterol. Monounsaturates and polyunsaturated have been found to lower blood cholesterol, but that does not grant permission for liberal use. Recently the monounsaturated oils have taken center stage for being most healthful. Olive oil has captured the most attention because of its generous use among Mediterranean populations and their low incidence of heart disease. Another benefit of monounsaturates is that they do not seem to lower the good HDL cholesterol to the same extent as the polyunsaturates. Polyunsaturates lower cholesterol, LDL and HDL. Monounsaturates seem to lower cholesterol and LDL but not HDL.

Of course, if our diets contained less than twenty-five percent fat that would become a moot point. We wouldn’t need to concern ourselves with trying to counterbalance one lipid against another because in that range of fat intake we would be protected from heart disease. Greeks and Chinese have the lowest rate of heart disease in the world. Greeks eat largely pasta, rice, beans, vegetables, and olive oil—fat makes up almost forty percent of their diet compared to only fifteen percent fat among the Chinese.

On the face of it olive oil looks like a life saver. Based on what we presently understand, olive oil does seem to present less risk for heart disease. However, a point often overlooked is that both Chinese and Mediterranean peoples eat more fruit and vegetables and less meat than we do, and are more active than we are. When the Mediterranean diet was studied it was found that people on Crete and in southern Italy were eating twice the whole grains and fiber that we do. The Chinese eat three times the fiber that we do. This finding gives ample indication of a diet which emphasizes plant based foods. Thirty-five years ago when the

habits of the rural residents of Crete were first being observed by researchers, not only did they spend most of the day working in the fields or doing chores, but few had cars or other modern conveniences. They also had a steady diet of walking and manual labor. Rural areas of China experience similar conditions even today. Both cultures also embrace a more stable family network and a less frantic pace of life than the American way. It will be interesting to see what we continue to discover from updated studies. Heart disease is not our only concern. A high fat diet is also linked to a growing number of cancers.

The risk of a high fat diet is perhaps most pronounced in the development of colon cancer. There is not a single population in the world with a high meat intake which does not have a high rate of colon cancer.***32** As John Robbins in his book, A Diet For A New America so clearly describes, "The human intestine has a very hard time handling the putrefying bacteria, high levels of fat, and lack of fiber that characterize meat, dairy products and eggs. The human intestine is anatomically very different from that of the natural carnivores, such as dogs and cats.... Dogs, cats and other natural carnivores do not get colon cancer from high-fat, low-fiber, flesh-based diets. But we do."***33**

Giving his expert opinion about what medical science now understood about diet and cancer, Dr. Gio B. Gori told a Senate Select Committee that "Until recently, many eyebrows would have been raised by suggesting that an imbalance of normal dietary components could lead to cancer and cardiovascular disease . . .. Today, the accumulation of... evidence... makes this notion not only possible but certain....

"(The) dietary factors responsible [are] principally meat and fat intake."***34** Dr. Gori is Deputy Director of the National Cancer Institute's Division of Cancer Cause and Prevention and is director of its Diet, Nutrition, and Cancer program.

Dr. Mark Hegstead, nutritional scientist from Harvard University concurs: "I think it is clear that the American diet is indicted as a cause of coronary heart disease. And it is pertinent, I think, to point out the same diet is now found [guilty] in terms of many forms of cancer: breast cancer, cancer of the colon and others."***35**

Another form of cancer now widely acknowledged as correlated to fat intake is cancer of the prostate, and again it is fat from animal products that is the culprit. The University of California at Berkeley *Wellness Letter* of February 1994 (Vol. 10, issue 5) reported on prostate cancer and the intake of red meat. A study of 48,000 men from age forty to seventy-five was published in the *Journal of the National Cancer Institute*. It found that those who ate the most fat had a seventy-nine percent higher risk of advanced prostate cancer than those who ate the least fat. Men who ate the most red meat had a 164 percent higher risk than those with the lowest intake. The focus of this study was on fat as it relates to the advanced conditions of prostate cancer. However, Harvard researchers suggest fat intake may account for the variation in the rate of disease

progression. Avoiding red meat may also avoid the development from a symptomless disease to an invasive, life threatening one. Smoking also influences the prostate disease process. But of course to smoke and to be health conscious is almost a contradiction in terms. Prostate cancer is most widespread among men who live in the U.S., Canada, and Northern Europe. It kills about 100 American men daily.

The relationship between diet and disease is not always fully understood. There are still several studies being done on the role of fat in the development of breast cancer. This relationship is not clear-cut nor uniform in all data results to date. However, "countries with a higher intake of fat, especially animal fat, have a higher incidence of breast cancer. This has been found not just once or twice but repeatedly in very carefully conducted studies.... Animal products are apparently a bigger problem than vegetable oils.., but some studies of lacto-ovo vegetarians (those who eat dairy products and eggs) have found their cancer risk is almost as high as meat eaters. These vegetarians were avoiding meat but eating considerable amounts of dairy products that, like meat, contain animal fat and not a speck of fiber."***36** For some time it has been known that breast cancer seems to be familial— insinuating a genetic link. Just recently researchers have discovered the gene which predisposes certain women to breast cancer. However, it is still not known what triggers the gene to express the disease. Perhaps that is where dietary fat comes into play.

It should also be mentioned that according to the National Institutes of Health, as reported in the November 1993 Hope Health Letter, two alcohol-containing drinks a day can raise the estrogen levels in women enough to put them at a higher risk of breast cancer. Various studies over the past ten years show that women who drink moderately have a breast cancer risk forty to one hundred percent greater than those who do not. Increased saturated animal fat intake is a risk factor in endometrial cancer as well. The Nutrition Action Health Letter of November 1993 reported that women with endometrial cancer were more likely to eat a diet high in saturated fat than their cancer-free counterparts.

The effects of these various kinds of fat can at times be confusing, and certainly there are other factors involved, but the simple message is to eat less fat. In the September 1992 Nutrition Action Health Letter a question was raised about the minimum amount of fat necessary for health. The answer indicated that there is only one fatty acid that the body cannot make for itself. It is polyunsaturated and is found in most oils, particularly soybean, safflower and cottonseed, and in smaller amounts in whole grains, vegetables, and beans. It would be difficult to become deficient. The two lipid factors most often incriminated in the disease process are cholesterol and saturated fat. The body has no dietary requirement for either one; it makes all it needs on its own. Both of these lipids are the signature of animal products. That should speak for itself.

COMPARING VEGETABLE OILS*37

	Type	Unsaturated Mono (g)	Unsaturated Poly (g)	Saturated (g)
BEST	Almond	10	2	1
	Olive	10	1	2
	Canola	8	4	1
	Peanut	6	5	2
GOOD	Corn	3	8	2
	Cottonseed	2	7	4
	Safflower	2	10	1
	Sesame	5	6	2
	Soybean	3	8	2
	Sunflower	3	9	1
	Walnut	3	9	1
WORST	Coconut	1	—	12
	Palm	5	1	7
	Palm kernel	2	—	11

Highly monosaturated oils are the best for cooking because when overheated they do not develop as many "free radicals" as polyunsaturated oils do. Free radicals are chemical agents that may be dangerous to human cells, and will be discussed in a later section. All oils are one hundred percent fat, so if you increase your use of olive oil, that must be balanced with a decreased use of other oils. It would be a wise replacement for saturated animal fat.

Our biggest impediments to behavior change seem to be from at least two counterproductive mental strategies. First is repetitious thinking about how much we wish we could just wave a magic wand, or find a magic pill or potion, which would automatically transform our behavior without any effort on our part; and second, we spin our wheels with thoughts and feelings regarding how deprived we are without whatever it is that we are trying to let go of. It has been my observation throughout many years of assisting others to meet their desired health goals, that those who are most successful in making change of any kind are those who have concluded that what they have to gain far outweighs what they will leave behind. For those persons, letting go of a detrimental habit does not signify deprivation, but freedom, and passage to a richer experience.

I am not advocating a fat-free diet, but rather hoping to underscore that there seem to be certain fats which have more harmful consequences than others. The ideal would be to let go of those fats which are detrimental. It is a more healthful choice to prepare our food free from grease. It's a tall order, but all fat should be used with discretion. It can be done. A study was conducted by the Fred Hutchinson Cancer Research Center in Seattle on 650 women. These women were instructed how to reduce fats in their diet and then monitored by a

psychologist. Four out of five of these women were able to lower their fat intake from the typical American level of about thirty-seven percent of calories to twenty percent and keep it there. Some even lowered their intake to fifteen percent voluntarily. Four years later they were given a preference test which entailed rating high fat foods, such as potato chips and certain kinds of cookies among others. When their responses were compared to women who had had no instruction and were not following a low-fat regimen, they found that for those on the low-fat diet, the high-fat foods had lost their appeal. Somehow these women had developed a distaste for foods once considered tasty. What made the difference? Researchers suggested it could have been a psychological difference in their thinking about these foods, or it may have been that high fat foods made them feel physically uncomfortable due to the increased time it takes these foods to leave the stomach.***38** It most likely was a combination of these and other factors. We do know that habits of all kinds create well-developed pathways in our nervous system, thereby facilitating the continuation of our behavior. That can work for or against us depending on our choices. Every action, positive or otherwise, prepares the way for its repetition. The good news is that establishing new pathways in our nervous system does not take long.

Over one hundred years ago, in 1877, Dr. John Harvey Kellogg, a vegetarian interested in disease prevention and world renowned for his work as a physician at Battle Creek Sanitarium in Michigan, spoke words of wisdom regarding the altering of fat from the form in which it occurs in nature. He perceived free fat, separated out from its natural food source, to be unwholesome, while at the same time he discouraged the use of butter and lard because of his concern that concentrated forms of fat were not processed well by the body. He advised that an attempt to replace butter or lard with a vegetable substitute would be open to the same objections as using the products they were intended to replace. Indeed, today we find ourselves in the position of debating the pros and cons of the diet margarines as well as an entire host of products into which trans fats have been introduced, and wondering just where the virtues lie. One undebatable truth emerges. The closer food is to its natural state, the more life protection it contains.

A RECAP OF FATS

Cholesterol: A waxy, fatlike substance, classified as a lipid and found in all tissues in humans and other animals. It is thus in all foods from animal sources—meat, eggs, fish, poultry, and dairy products. No plant-derived food contains cholesterol. Cholesterol is essential to life. It is part of all cell membranes, certain hormones, vitamin D, and other substances. The body makes all the cholesterol it needs; you don’t need to consume any to stay healthy.

Lipoproteins: Packages of proteins, cholesterol, and triglycerides, assembled by the liver and circulating in the blood.

LDL, or low-density lipoprotein carries cholesterol through the bloodstream, dropping it off where it is needed for cell building—and leaving any unused residue of cholesterol in the arterial walls. Since it takes cholesterol into the system, LDL is referred to as “bad” cholesterol. It can be oxidized (combine with oxygen) in the bloodstream, and that may enhance its ability to produce the artery-blocking plaques that can lead to heart attack.

HDL, or high-density lipoprotein, as it circulates in the bloodstream, picks up cholesterol and brings it back to the liver for reprocessing or excretion. Because HDL clears out cholesterol, it is referred to as “good” cholesterol.

Triglycerides: These fats circulate in the bloodstream along with cholesterol and other lipids. They come from the food we eat; they are the body’s stored form of fat. Thus when people say, “I’m too fat,” you might say their triglycerides are showing. The body can also assemble triglycerides in the liver.

Atherosclerosis: A condition in which nodules, called plaques, are formed in the walls of the blood vessels; they can obstruct the flow of blood and promote the formation of blood clots on the plaques. The plaques are made of cholesterol, fats, and other substances that build up in the bloodstream. The plaques and clots may ultimately cut off the flow of blood; in the coronary arteries that can lead to a heart attack, in the cerebral arteries a stroke.

Definitions taken from University of California at Berkeley Wellness Letter, December 1993, Volume 10, Issue 3.

PROTEIN—DNA, GROWTH, AND REPAIR

Now we will turn our attention to protein, the last of the trio of the calorie-containing nutrients. No new living tissue can be made without protein. It is a part of every cell, every bone, the blood, and all other tissues. Protein does the cells’ work. The energy to fuel their work comes from carbohydrate and fat as these are broken down. In terms of chemical configuration, proteins are long chains of amino acids. Most of these chains are composed of 100 to 300 amino acids and are called polypeptides because they contain more than ten amino acids linked together. There are twenty-two amino acids which can be linked together in a seemingly endless number of ways to form the estimated ten thousand to fifty thousand different kinds of protein which the body contains. Presently we know the roles of only a thousand of these proteins.***39**

Our individual uniqueness is determined by only the tiniest differences in body proteins. These differences are determined by the amino acid sequences of proteins written into the genes which we inherited from our parents and all of those who form the numerous branches of our family tree. The compelling masterpiece of artistry known as DNA is the storage center for genetic material and provides the blueprint for the specific nature of every cell in our body. Thus we can see that it is a physical, physiological phenomenon which forms the foundation of our being. The marvels of DNA are a constant source of intrigue

to science. The genes direct the making of all the body's proteins. The wide array of proteins which are made are specialized to carry out their specific tasks.

Enzymes are a kind of protein essential to all life processes. Enzymes are what put together the amino acid chains. They act as catalysts to facilitate the building up or breaking down of compounds in the body, thus they are constantly involved in assembly and dismantling. This process repeats itself billions of times daily, and that is how a living system renews itself. It's what makes possible the rebuilding of every bone in your body within only two years' time. All of the body's tissues and organs—muscles, bones, blood, skin, and nerves—are made largely of protein.***40** Because all of what we are is inscribed in our genetic code, we want to do all we can to protect its integrity. We can make a substantial contribution toward defending our genetic control center from potential damage by choosing our nourishment wisely and guarding against unnecessary exposure to toxins in our environment. Our genetic code does not belong to us alone; it is passed on from one generation to the next.

Protein also helps maintain the body's fluid balance and the especially critical balance between acids and bases. An imbalance here can be fatal. Other proteins act as antibodies against viruses, bacteria, and disease agents. Within five hours, a healthy person can reduce a million bacterial cells injected into the skin to less than ten. Thus protein is necessary to resist disease.***41** Certain hormones, such as insulin, are composed of amino acids. Another group of proteins specializes in moving or transporting nutrients in and out of cells or within the body fluids. The protein hemoglobin carries oxygen from the lungs to body cells. The lipoproteins mentioned earlier, HDL and LDL, transport lipids around the body.

That is by no means an exhaustive depiction of protein's importance. But it does permit a bird's-eye view of the diverse ways in which protein functions in our body. It is little wonder that it came to be regarded as the centerpiece of our meals for as long as most of us can remember. Protein in food does not provide body protein directly; it must be broken down into the amino acids from which protein is made. The body is able to make for itself thirteen of the twenty-two amino acids it needs. Nine amino acids are essential for us to get from our food. They are referred to as "essential" because either the body doesn't make them at all or it doesn't make them fast enough to supply its needs. A protein-containing food is called complete if it contains all nine essential amino acids in adequate amounts for human use.***42**

According to this definition all animal products contain complete protein. Eggs are considered the prima donna of the protein standard; however, they suffer miserably from high cholesterol. If you are willing to discard the yolks, you will also eliminate the cholesterol. The whites are where the protein is concentrated. Plant foods deliver their protein in a different way. There was a time when it was thought that plant proteins had to be carefully combined at each meal in order to provide complementary proteins of adequate nutritional

value. That is no longer considered necessary. Choosing from a variety of grains, legumes, fruits and vegetables will provide ample amounts of protein. In fact it is hard to fall short of our protein needs; nature seems to have placed it in almost everything. It may be surprising to some that forty-nine percent of the calories in spinach come from protein, or that protein contributes forty-five percent of the calories in broccoli and brussels sprouts. Even a mushroom delivers thirty-eight percent of its calories in protein. In some countries mushroom sandwiches are considered a delicacy. A study in the Journal of the American Dietetic Association compared the intake of essential amino acids for meat-eaters, lacto-ovo vegetarians (those who eat dairy products and eggs), and pure vegetarians (no animal products) and discovered all three diets exceeded requirements by at least twice the amount, and most of the participants in the study exceeded requirements by large amounts.***43** Perhaps some of our zeal for the virtues of animal protein can be explained by a look at the premise upon which this reputation is founded. Keep in mind that a conclusion is only as good as the premise on which it was built.

It seems we must go back to 1914 when experiments were being done on rats to see which grew faster—those on animal or vegetable sources of protein. They discovered that rats grew faster on the animal protein, and investigators began to classify meat, eggs, and dairy foods as "Class A" and those from plant origin as "Class B." They then studied just what amino acid combination promoted the fastest growth and discovered the egg was especially conducive to rat growth. Now it's true that we often derive research data from animal experiments, but in this case the Egg Board, Dairy Council, and Livestock and Meat Board all saw a great opportunity to promote their products without considering whether the growth rate for rats was actually related in any significant way to the growth rate in humans. The researchers themselves were not able to make this connection, and naturally it was impossible to carry out this same experiment on humans.***44**

However, we can look at the difference in growth rates of rats and humans and compare the protein content of the natural mother's milk designed to promote growth in the species to obtain a clue as to why it might be of benefit for a rat to consume protein from an animal source. This is how human milk and rat milk compare. I've also included cow's milk as a point of interest: ***45**

Type	Percent calories as protein	Number of days to double birthweight
Human	5%	180
Cow	15%	47
Rat	49%	4

As it turns out, mother's milk, at 5 percent, falls right in the middle of the 2.5 to 10 percent range which reputable organizations and researchers

recommend as the percent of protein calories needed to satisfy our nutrient needs. The top end of this range includes about a thirty percent buffer to protect the individual who for some reason may have higher than average needs.***46** This data would seem to suggest that human and rat requirements are extremely different. In fact, if we add life expectancy into the mix, it might be extrapolated that a high protein intake and rapid growth rate decrease the life span, since the average rat does not live longer than four years. It is little wonder that it needs to grow rapidly. From what we presently know, rapid growth or maturation actually has its drawbacks in humans, especially in females reaching puberty at an early age.

The World Health Organization has been gathering statistics on the age of puberty worldwide for over a hundred years. In 1840 the average age at menarche***** in Western countries was 17. Today it is 12.5.***47** Imagine how this single factor alone affects our societal problems in terms of the growing numbers of unwed mothers and the string of future implications associated with a child raising a child. The March 1994 (Vol. XIV, No. 3) issue of the Hope Health Letter, produced by The Hope Heart Institute, stated that “teen pregnancy is at the root of nearly every other social problem in the U.S. Ninety percent of Americans who are currently serving time in U.S. prisons were born to teenage mothers. Pregnancy is the leading reason young girls drop out of high school, and the public-assistance tab for teen mothers and their children in 1991 was 26 billion dollars.” Ninety percent may be on the high end of the statistical range describing this population—but the statistics are high and alarming regardless of which report is being read on the topic of teen pregnancy. The age at onset of menses has been slowly dropping in England, Norway, Denmark, and Finland as well. Even in Japan, the age at menarche has dropped from 15.2 to 12.5 over the past four decades due to the Westernization of their diet. Early menarche is also a risk factor for breast cancer. Once again, it is an increase in meat and dairy products which is nurturing these changes.

***** Menarche: the first occurrence of menstruation.

The interrelationship of increased fat and protein with a decrease of fiber, vitamins, and minerals from the plant kingdom is taking its toll on hormone production as well as everything else, not to mention the questionable effect of ingesting the hormones fed to animals.***48** China, with its mainstay of rice and vegetables, little meat, and virtually no dairy products, retains an average age at menarche of seventeen—the range being between ages fifteen to nineteen.***49** Unfortunately, when we speed up the biological process of maturation we also speed up the process of aging. There is sketchy evidence that boys may also be reaching puberty earlier. That is much more difficult to assess, since boys do not reach puberty in an equally measurable way as do girls. However, studies in England point out that English schoolbus seats are becoming increasingly more

uncomfortable for the average thirteen-year-old boy than was so a generation ago.***50**

Since we are talking about boys, it seems men in general are more susceptible to the belief that it is protein that makes one strong, therefore the more protein I eat, the stronger and more manly I become. That is a mistake. Even Arnold Schwarzeneggar, world renowned body builder, doesn't advise protein intake above the recommended range of between 2.5% to 10% of calories as a part of his formula for basic good eating.***51** There is also no greater demand for protein from hard physical work. The National Academy of Science states, "There is little evidence that muscular activity increases the need for protein."***52** As we've already learned, it's carbohydrates that provide the premium fuel for activity.

The difference between the arrangement of amino acids in plant and animal protein seems to make a difference in lowering cholesterol. A study reported in the June 1993 Nutrition Action Health Letter showed that when sixty adults with high cholesterol were switched from a low-fat diet that included meat and dairy foods to a low-fat diet that got all of its protein from soybeans, their average cholesterol dropped by twenty-five percent in eight weeks. Another sixty-five adults lowered their cholesterol by thirteen percent in just four weeks by replacing half of their meat protein with soy protein; when they switched to all soy protein it dropped an additional six percent in another four weeks. That can make a substantial difference in risk for heart disease, since every one percent drop lowers risk by two percent. Thus a twenty-five percent drop in cholesterol translates into a fifty percent lowered risk for heart disease. This study was done with soy protein and may not necessarily show the same results for every kind of plant protein, but it does demonstrate that the difference between plant and animal protein does not make plant protein inferior. In this case, just the opposite is true.

We continue to perpetuate the delusion that animal foods are the high class—Class A—carriers of nutrients. The world is full of prestigious eating establishments which pride themselves in fine cuts of meat, fish, seafood, and dairy concoctions. I admit it would be hard to swallow a price of thirty-five dollars or more for a plate of grains, legumes, vegetables, or fruit. Yet as the evidence mounts regarding the superlative status of these plant foods, we are still entrapped in the misconception that animal food is glamorous and the best indication of a sophisticated palate.

I cannot stress enough that the proportion or ratio of nutrients occurring in a food is vital to the way our bodies use it. Nature arranges plant nutrients in a specific way. There is nothing accidental about this nutrient arrangement. The interplay of "nutrients in balance" and the chemistry this creates keeps returning as we study the process of disease.

This concept of nutrient interplay, and the problems caused by excessive protein, become glaringly evident in the development of osteoporosis, a dreaded

concern for most women as they get older, and a killer which outranks cancer of breast and cervix combined.***53** Osteoporosis demonstrates the intricate balance required among protein, calcium, vitamin D, phosphorus and, according to some researchers, magnesium and boron.***54 *55** Dr. Neal Barnard states, "The key to bone strength is not to maximize calcium, but to minimize calcium loss."***56** Vitamin D is necessary for calcium absorption and regulation. Generally, as long as one is regularly exposed to sunlight, getting enough vitamin D is not a problem. Most of what we hear about osteoporosis centers on getting enough calcium.

We are encouraged to eat more dairy products because they are the best source of calcium—that sounds logical. Interestingly, the countries which consume the most dairy products, the U.S., Finland, Sweden, and the United Kingdom, also have the highest rates of osteoporosis.***57** So what seems to be happening here? Researchers in Madison, Wisconsin, compared the diets of 300 pre-menopausal women age twenty to thirty-nine and found that the amount of calcium in their diet had no measurable effect on bone density.***58** That is at a time of peak bone mass.***59** Yet calcium intake spanning the normal dietary range led to no stronger bones than the lower calcium diets. Post-menopausal women have also been put to the test since that is a time period of greatest bone loss. The same results are found. As long as one is not grossly deficient in calcium, supplements and dairy products do not have much effect on bone density.***60**

So if we can't prevent osteoporosis with extra calcium, what will make a difference? "Throughout the world, the incidence of osteoporosis correlates directly with protein intake."***61** "Diets that are high in protein, especially animal protein cause more calcium to be excreted. If they consume more modest amounts of protein, they lose much less calcium in the urine."***62** Dr. John McDougall, noted author on the relationship between diet and disease, states, "I would like to emphasize that the calcium-losing effect of protein on the human body is not an area of controversy in scientific circles. The many studies performed during the past fifty-five years consistently show that the most important dietary change that we can make, if we want to create a positive calcium balance that will keep our bones solid, is to decrease the amount of proteins we eat each day. The important change is not to increase the amount of calcium we take in."***63**

And apparently it's not only the quantity of protein, but the kind of protein as well which is involved. Meats are high in sulfur-containing amino acids which cause the blood to become more acid (you recall the acid-base ratio is of vital importance in body regulation). So to neutralize this acidic effect, it is believed that bone material is dissolved, leading to a loss of calcium in the urine. Animal flesh also contains large quantities of phosphorus which can impair calcium balance. This process is under study, but scientists believe diets which maintain calcium and phosphorus in more equal proportion help keep calcium in

the body. Beef has a high phosphorus-to-calcium ratio, 15:1, and chicken breast about 14:1. Vegetables and fruit have a much better balance: carrots, 1.7:1, peaches, 2:1, and broccoli about 0.4:1.***64**

You will see as we continue that there is an arsenal of protection in the plant world, and that leafy greens are especially nutrient laden (dense). Many, such as broccoli, collards, and kale, are good calcium sources, and as reported by the *American Journal* of Clinical Nutrition, have higher calcium absorbability than milk. Milk contains a substantial amount of calcium, but only about thirty percent of it is absorbed; and in just one glass, you are also getting eight grams of animal protein which additionally encourages calcium loss.***65**

Another element under investigation is boron; it too appears to be important in calcium retention. We don't yet know just how much we need of it, but we do know where to get it. You guessed it: a balanced diet including fruit, vegetables, nuts, and legumes will supply our requirements.***66** "Postmenopausal women fed diets that were supplemented with three mg. of boron excreted about twenty percent less calcium in their urine than the unsupplemented women. In addition, the blood estrogen levels of the boron supplemented women more than doubled, giving a blood level similar to those women who were on estrogen replacement therapy."***67**

It is also well known that exercise is important in preserving bone density. If bones are not being used, they will not be as likely to retain their strength. "Finnish women aged fifty to sixty who participated in physical activity for four or more hours per week had significantly higher bone mineral density than the women who were much less active. Research at Tufts University showed that the spinal trabecular bone density (the lacy inner bone that supports the bone's structure) in sedentary postmenopausal women, of average age sixty, decreased seven percent over one year while those similar women who walked one hour a day, four times a week had no loss of bone mineral density."***68** And if a woman is a smoker, quitting is the best advice not only in prevention of osteoporosis, but for a legion of reasons which hold true for anyone.

The osteoporosis anxiety has created a competitive market for calcium supplements. If you think you need one, calcium-fortified orange juice contains no animal protein and is more easily absorbed than calcium carbonate supplements.***69** One more detriment of a high protein diet is overwork of the kidneys. Since by-products of protein metabolism are eliminated in the urine, excess protein intake means the kidneys have more work to do.

Undoubtedly, the controversy between those who believe "milk does a body good" and those who think it does more harm than good will continue. Nobody refutes the importance of a balance between calcium and protein in the prevention of osteoporosis, but there are many who regard authors like McDougall as having an extreme, exaggerated point of view. One thing we do know: the interplay of nutrients keeps coming up over and over again. In order to evaluate different perspectives, we must have some way to determine what

makes the most sense. We must look at the direction research seems to be pointing as it enhances our understanding of how our lifestyle choices influence health. Evidence does indeed continue to grow. Researchers have discovered a link between the buildup of galactose from the breakdown of the milk sugar, lactose, in the body and the development of both cataracts and ovarian cancer.***70** However, many consider that to be a weak, inconclusive link.

In other studies, ovarian cancer has been linked to egg in-take.***71** There may have been a time when milk was safer for consumption than it now is. Times have changed considerably from the days of the family cow. The "processing" of animals for market is unconscionable in many ways, which we will touch on in a later chapter. When it comes to milk, one veterinarian working for California's Department of Agriculture observed that forty to eighty percent of milk cows test positive for leukemia. ***72** "A cow may have leukemia for months before she is ill enough to be removed from the milking herd. During that time she would not only infect other cows by contact, but she would also transmit cancer viruses into her milk for human consumption."***73** Added to this there are questions regarding the effectiveness of pasteurization in inactivating viruses; some suggest milk be sterilized for at least ten minutes before it is used.***74**

And then there are all those added hormones, the implications of which are questionable and not fully understood. We do know that hormones are a crucial component in the regulation of our bodies, that foods influence the amount of various hormones in our body, which in turn mediates a host of bodily responses from mood to immunity.***75** Our understanding is not yet complete, but there is definitely a dangerous relationship between increased fat intake, especially animal fat, and the way in which it affects the two characteristic male and female hormones, testosterone and estrogen. Increased animal fat increases levels of both testosterone and estrogen, thereby increasing the risk for cancers that are related to "maleness" and "femaleness"—prostate cancer, breast cancer, endometrial cancer, and ovarian cancer. All I can add is to be prudent, be cautious, and be aware.

One well-known example of the importance of hormone levels to body regulation is in the case of insulin and the development of adult-onset diabetes. Insulin is a hormone made by the pancreas; it is the key which opens the way for glucose, the body's prime fuel, to enter our cells, enabling them to do their work. Adult-onset diabetes usually occurs in people who are over forty, over-weight, and do not exercise. It is due in large part to the way the person has been eating and to lack of exercise. Years of high-fat, low-fiber, calorie-rich food have created chronic excess demand on the system and have rendered the cells less capable of letting the insulin in. This affects not only the way the body handles sugar, which is the most common association with diabetes, but how it handles protein and fat as well. Often, regular exercise and a reverse diet of low-

fat, high-fiber, nutrient-dense food will reduce the calories in the diet, lower weight, and greatly reduce or eliminate the condition.

CONCLUSION

It is evident we play a major role in how our bodies function. Imbalance often brought about by dietary excess of one nutrient or another has a far-reaching domino effect. It is unfortunate that there is generally an extended period of time which passes before we comprehend the consequences of our eating habits. We can't always wait until all of the evidence is in. Although what we know about the human body and how it functions would fill several libraries, what we don't know would probably fill an ocean. When you consider that we know of one thousand proteins compared to the ten thousand to fifty thousand estimated to exist, you begin to catch a glimpse of the complex dynamic which keeps the fire of life glowing within our being. Then, when you extend this concept to our comprehension of the marvels of brain capacity, it is more likely that we will someday have vacation homes on Pluto than that we will ever settle the unknown frontier of the human mind.

Statistics and research are interesting and valuable. There is a plethora of information about fat—saturated fat, trans fat, polyunsaturated and monounsaturated fat, HDL, LDL, omega-6s, and omega-3s. It's easy to feel overwhelmed and confused by the ever-expanding amount of information, and the fact that there is not always agreement regarding interpretation of results. It may seem that healthful eating is far too complicated, that it's an impossible juggling act in which there just isn't anything left that's safe to eat; and even worse, if it tastes good, it probably isn't good for you.

I would like to be fair-minded and present more than one point of view, but as one examines the research, it all seems to point in the same direction—the superior benefit of the plant kingdom in supporting optimal body function and in protecting us from disease. As science continues to enhance our understanding of the ways these benefits translate into chemical reactions, we can take our cues from the way plant foods are designed in nature and apply these sound principles to the way we evaluate our food choices and form our eating habits.

From what we have explored thus far, these are the key nutrient differences between plant and animal products as they relate to health and disease prevention:

- Nature doesn't package cholesterol in any food.
- Nature supplies primarily unsaturated fat.
- Nature generally packages this fat in small quantities, except in nuts and seeds.
- Nature never packages fat without fiber and an array of vitamins and minerals.

- Nature never packages protein without fiber and an array of vitamins and minerals.
- Nature generally includes carbohydrate, protein, fat, vitamins, minerals and water together in all plants in more modest quantities rather than large concentrations of just one element.
- Nature has equipped plants to be our major source of energy and protection from disease.

Contrast that with animal products:

- Flesh and dairy foods all contain cholesterol.
- These foods supply saturated fat.
- These foods supply the dangerous combination of both cholesterol and saturated fat together.
- Cholesterol and saturated fat are in larger quantities than the unsaturated fats in plant foods.
- Fat comes without fiber.
- Protein comes without fiber.
- These foods are noted for supplying only a few elements, in higher concentrations, rather than a wide array of nutrients in modest amounts.
- Flesh has no significant carbohydrate, the body's premium fuel.

These foods do not offer a wide array of the protective vitamins and minerals. Judge for yourself how that compares with what we know about how to keep our being vibrant with health:

- The body needs no intake of cholesterol or saturated fat.
- The body prefers carbohydrate as its major fuel.
- We eat far more protein than we need, and excess of anything—fat, protein, or carbohydrate—can disturb the balance and regulation of body processes.
- Plants provide the wide array of vitamins, minerals and fiber required to accomplish these body processes.
- Excess cholesterol and fat, derived primarily from animal sources, seem to be significant factors in the process of disease.
- Excess protein and fat contribute to speeding up the maturation process which in turn speeds aging as well.

It is my contention that eating healthfully was not meant to be difficult. If our appetites were developed to appreciate food as it comes from the hand of nature, it would not seem such an arduous task to meet all of our nutrient needs in a balanced manner without the threat of diseases which stem from the excess

of certain nutrients at the expense of deficiencies in others. We would have no calories to count, little problem maintaining an appropriate weight, medical costs would be limited, our minds would be clear, our attitudes positive, and we wouldn't be encumbered with trying to make sense out of all of the redesigned, refined, reconstituted food products which cost more and deliver less.

Everyone knows that far too many people are dying unnecessarily of preventable diseases. Whether it be ten or ten thousand a day, it's too many, and especially if that statistic includes someone you love. I hope the testimony we give to the next generation will not be that one of the most technologically advanced societies of all time finally achieved the intellectual capacity to personally select the disease of their demise and proved conclusively that it is indeed possible to dig a grave with one's teeth. Fortunately, we do not have to follow a complicated set of instructions that change from one disease to the next in order to protect our health. A few simple guidelines cover the gamut. Eat less fat, eat more grains, legumes, fruit and vegetables (which translates to eating more plant food while steadily decreasing the animal products), drink plenty of water, exercise regularly, and keep a tranquil, thankful heart.

The following charts may be helpful in making nutrient comparisons.

PERCENTAGE OF CALORIES AS FAT

MEAT

Sirloin steak, hipbone*	83%
Pork sausage	83%
T-Bone steak*	82%
Bacon, Lean	82%
Porterhouse steak*	81%
Rib roast*	81%
Bologna	81%
Country style sausage	81%
Spareribs	80%
Frankfurters	80%
Lamb rib chops*	79%
Duck meat, w/skin	76%
Salami	76%
Liverwurst	75%
Rump roast*	71%
Ham*	69%
Stewing beefs	66%
Goose meat, w/skin	65%
Ground beef, fairly lean	64%
Veal breast*	64%
Chicken, dark meat with skin, roasted	56%
Round steak*	53%
Chuck rib roast, lean only	50%
Chuck steak, lean only	50%
Turkey, dark meat w/skin	47%
Sirloin steak, hipbone,lean only	47%
Lamb rib chops, lean only	45%
Chicken, light meat w/skin roasted	44%

DAIRY PRODUCTS

Butter	100%
Cream,whip/light	92%
Cream Cheese	90%
Cream,light & coffee	85%
Egg yolks	80%
Half & Half	79%
Blue Cheese	73%
Brick cheese	72%
Cheddar cheese	71%
Swiss cheese	66%
Ricotta (whole milk)	66%
Eggs, whole	65%
Ice cream (16%)	64%
Mozzarella (part skim)	55%
Goat's milk	54%
Cow's milk	49%
Yogurt, plain	49%
Ice cream, regular	48%
Cottage cheese	35%
Low fat milk (2%)	31%
Low fat yogurt (2%)	31%
Ice milk	29%
Non-fat cottage cheese (1%)	22%

***lean, with fat**

Source: Nutritive Value of American Foods in Common Units
USDA Handbook #456

PERCENTAGE OF CALORIES AS FAT

VEGETABLES

Mustard greens	13%
Kale	13%
Beet greens	12%
Lettuce	12%
Turnip greens	11%
Mushrooms	8%
Cabbage	7%
Cauliflower	7%
Eggplant	7%
Asparagus	6%
Green beans	6%
Celery	6%
Cucumber	6%
Turnip	6%
Zucchini	6%
Carrots	4%
Green peas	4%
Artichokes	3%
Onions	3%
Beets	2%
Chives	1%
Potatoes	1%

NUTS/SEEDS

Coconut	85%
Walnut	79%
Sesame	76%
Almond	76%
Sunflower	71%
Pumpkin seed	71%
Cashew	70%
Peanut	69%
Chestnut	7%

FRUIT

Olive	91%
Avocado	82%
Grapes	11%
Strawberry	11%
Apple	8%
Blueberry	7%
Lemon	7%
Pear	5%
Apricot	4%
Orange	4%
Cherry	4%
Banana	4%
Cantaloupe	3%
Pineapple	3%
Grapefruit	2%
Papaya	2%
Peach	2%
Prune	1%

LEGUMES

Tofu	49%
Soybeans	37%
Soybean sprouts	28%
Garbanzo beans	11%
Kidney beans	4%
Lima beans	4%
Mungbean sprouts	4%
Lentils	3%
Broad beans	3%
Mung beans	3%

GRAINS

Oatmeal	16%
Buckwheat, dark	7%
Rye, dark	7%
Whole wheat	5%
Brown rice	5%
Corn flour	5%
Bulgur	4%
Barley	3%
Buckwheat, light	3%
Rye, light	2%
Wild rice	2%

FISH

Tuna, chunk, in oil	63%
Herring,Pacifics	9%
Anchovies	54%
Bass,black se	53%
Perch,ocean	53%
Caviar, sturgeon	52%
Mackerel, Pacific	50%
Sardines,Atlantic oil drained	49%
Salmon, sockeye	49%

An interesting discovery about nuts is that even though they are high in fat (not the saturated kind) they do not seem to raise cholesterol levels. In fact, individual studies done with walnuts and almonds have demonstrated that both actually lower cholesterol.

CHOLESTEROL CONTENT OF SELECTED FOODS
(mg per 100 g portion)

ANIMAL		PLANT	
Egg, whole	550 mg	All grains	0
Kidney, beef	375 mg	All vegetables	0
Liver, beef	300 mg	All nuts	0
Butter	250mg	All seeds	0
Oysters	200 mg	All fruits	0
Cream cheese	120 mg	All legumes	0
Lard	95 mg	All vegetable oils	0
Beefsteak	70 mg		
Lamb	70mg		
Pork	70mg		
Chicken	60 mg		
Ice cream	45 mg		

Source for both charts above: J. Pennington, Food Values of Portions Commonly Used, Harper and Row, 14th ed., New York 1985, in John Robbins, A Diet For A New America, Stillpoint Publishing, 1987.

PERCENTAGE OF CALORIES FROM PROTEIN AMONG PLANTS

VEGETABLES			
Spinach	49%	Cucumbers	24%
Kale	45%	Green pepper	22%
Broccoli	45%	Artichokes	22%
Brussels sprouts	44%	Cabbage	22%
Turnip greens	43%	Celery	21%
Collards	43%	Eggplant	21%
Cauliflower	40%	Tomatoes	18%
Mustard greens	39%	Beets	15%
Mushrooms	38%	Onions	14%
Chinese cabbage	34%	Pumpkin	12%
Lettuce	34%	Potatoes	11%
Green peas	30%	Yams	8%
Zucchini	28%	Sweet Potatoes	6%
Green beans	26%		

PERCENTAGE OF CALORIES FROM PROTEIN AMONG PLANTS (cont.)

FRUIT

Lemons	16%
Honeydew melon	10%
Cantaloupe	9%
Strawberry	8%
Orange	8%
Blackberry	8%
Cherry	8%
Apricot	8%
Grape	8%
Watermelon	8%
Tangerine	7%
Papaya	6%
Peach	6%
Banana	5%
Pear	5%
Grapefruit	5%
Pineapple	3%
Apple	1%

NUTS and SEEDS

Pumpkin seed	21%
Peanuts	18%
Sunflower seed	17%
Walnuts, black	13%
Sesame seed	13%
Almonds	12%
Cashews	12%
Filberts	8%

GRAINS

Wheat germ	31%
Rye	20%
Wheat, hard red	17%
Wild rice	16%
Buckwheat	15%
Oatmeal	15%
Millet	12%
Barley	11%
Brown rice	8%

LEGUMES

Soybean sprouts	54%
Mungbean sprouts	43%
Tofu	43%
Soybeans	35%
Broad beans	32%
Lentils	29%
Split peas	28%
Kidney beans	26%
Navy beans	26%
Lima beans	26%
Garbanzo beans	23%

Source: Nutritive Value of American Foods in Common Units, USDA Agriculture Handbook #456

One can see how easily protein needs can be met by eating a variety of plant foods. Brown rice, potatoes and soybeans are considered complete in themselves. Benefits abound in plants!

CALCIUM IN PLANT FOODS
(Serving is 1 cup cooked unless noted, in milligrams: RDA is 800 mg)

GREEN LEAFY VEGETABLES	mg.
Turnip greens	198
Broccoli	178
Scotch kale	172
Beet greens	164
Collard greens	148
Dandelion greens	146
Mustard greens	104
Swiss chard	102
Kale	94
Brussels sprouts	56
Looseleaf lettuce	38
Romaine lettuce	20

OTHER FRUITS AND VEGETABLES	
Dried figs (10 medium)	269
Canned wax beans	174
Tomato paste, canned	92
Boiled purslane	90
Stewed tomatoes, canned	84
Butternut squash	84
Boiled rutabaga	72
Papaya, 1 medium	72
Sweet potato	70
Onions	58
Green snap beans	58
Orange, 1 medium	56
Celery	54
Raisins, 2/3 cup	53

GRAINS	
Corn tortilla, 1 medium	42
Pita bread, 1 piece	31
Bagel, 1	23
BrownRice	23
Rye bread, 1 slice	20

Blackberries	46
Boysenberries	46
Raspberries	27
Lime, 1 medium	22
Strawberries	21
Mango, 1 medium	21
Kiwi, 1 fruit	20
Apple, 1 medium	20
Pear, 1 medium	19
Lemon, 1 medium	15

LEGUMES	
Firm tofu	516
Amaranth, 1 cup boiled	276
Tofu	260
Soybeans	175
White beans	161
Navy beans	128
Vegetarian baked beans, canned	128
Great northern white beans	121
Canned refried beans	118
Red Calif. kidney beans	116
Black turtle beans	103
Cranberry beans	89
Pinto beans	82
Canned garbanzo beans	78
Canned kidney beans	62
Baby lima beans	52
Green peas	38
Lentils	37
Lima beans	32

BOXED CEREALS	
Total cereal	48
Wheaties cereal	43
Quaker 100% Natural, 1/4c.	38
Post Fortified	

CALCIUM IN PLANT FOODS (CONT.)

Whole wheat bread, 1 slice	18	Oat Flakes	33
		Post Raisin Bran, 1/2 c.	15

Calcium may be used as a firming agent in canned or processed foods. Be mindful of sugar content in processed cereals.

Source: Jean A. T. Pennington, Bowes and Church 's Food Values of Portions Commonly Used, 15th Ed. 1989, Harper Perennial, Harper Collins Publishers, New York.

BORON SOURCES

Almonds, Hazelnuts, Peanuts	Orange Juice
Applesauce	Peaches
Broccoli	Pears
Carrots	Prunes
Cherries	Raisins
Grape Juice	Soy
Green Beans	

Sources: Adapted from Neal Barnard M.D., Food For Life, Crown Publishers, New York, 1993; and Winston J. Craig, Nutrition For The Nineties, Golden Harvest Books, Eau Claire, MI 1992.

Notice how so many of the same foods keep appearing on these lists. You can see why certain foods are considered to be much more nutrient-rich than others. You can also see how nature distributes nutrients in such a way that we would need to eat largely of the vegetables, legumes and fruits to meet our requirements. These foods are also generally low in calories, making it happily conducive to eat them in greater amounts.

One more illustration and we conclude this chapter. Studies on diet and disease have been ongoing for decades. Nearly forty years ago a study of Japanese men demonstrated that it is not just good genes, survival of the fittest, or some other nebulous characteristic that determines our health. This study compared a population with a very similar heritage, but with widely different lifestyles.

Japanese men	% Calories From Fat	Average Cholesterol	Deaths from Heart Disease
In Japan (Koga farmers, Shime miners)	10%	150	
In Hawaii	25%	220	4 times more
In Los Angeles	40%	250	10 times more

In general, the indigenous Japanese subsisted on a diet in which ninety percent of the calories came from plant sources and which was very low in refined foods. They were also physically active. The more animal fat the Japanese in Hawaii and Los Angeles ate and the less active they became, the more dramatic the influence on the incidence of heart disease.***76** The impact of diet and exercise on heart disease is well established, something we have been a long time learning. Evidence underscoring the significance of our choices in the scheme of things keeps mounting. Fortunately, nature is on our side.

Next we will examine nature's pharmacy—vitamins, minerals and phytochemicals.

3

Nature's Pharmacy

The value of nature's pharmacy is inestimable. It's not surprising that plants should contain substances which protect us from disease, since most of our medications are plant derivatives.

In fact, a recent evening news report on ABC extolled the benefits of Taxol in treating cancer. Taxol slows the growth of cancerous tumors. It also costs $1,987.00 per treatment. The news commentary focused on the enormous cost required to develop drugs. In the case of Taxol, it cost thirty million dollars for the National Institutes of Health to develop and another one hundred fourteen million dollars for development by the drug company. Even though Medicare and private insurance will pay for the medical costs, in order to make these drugs available for public use, the taxpayer must pay twice—once for research and again for development by the drug company. The source of this drug is found in the Yew tree. The treasure in this tree is only one example of nature's pharmacopeia.

We know that vitamins and minerals are essential for fending off disease, yet all of the ways in which they do so is a subject of seemingly exhaustless study. Several books have been written on the benefits and interactions of just one single vitamin. The more plant substances are studied, the more they keep turning our attention to the fact that when it comes to food there just isn't a more compatible and beneficial relationship to be found than that which connects man and plant. The discoveries which science is making about the protection these plant chemicals provide is an unfolding drama of amazing and incalculable proportions. It is as though nature never intended that anyone should have to pay two thousand dollars per cancer treatment or any of the other astronomical costs associated with acute medical care. The October 1993 issue of Executive Health reported that it costs $100 billion annually to treat heart attack, strokes, and other forms of heart disease. The January 1993 issue of the Hope Health Letter indicated it costs an average of $43,370.00 for bypass surgery. With half of America expected to develop heart disease, it is difficult to imagine how we can continue to keep paying these costs. I am not suggesting that we can eradicate all illness and disease just by making correct choices in what we eat, but I do believe that an ounce of prevention is worth a pound of cure. The health advantages to be gained from fruit, vegetables, grains, and legumes offer an important means of protection from disease, and they come at an almost trivial cost when compared to the price we pay for medication and technologically advanced acute medical care.

So let us begin our walk through nature's pharmacy with the vitamins C, E, and beta-carotene (beta-carotene is composed of two vitamin A molecules which

can be split as the body needs them). These have been dubbed the "antioxidants," and are believed to play a significant part in protecting us from heart disease and cancer. We will also look at the B vitamins, minerals, and other plant chemicals which contribute to keeping us well.

ANTIOXIDANTS—YOUR "A,C,E" AGAINST OXYGEN REBELS

Before we can appreciate what an antioxidant does for us, we must take another side-trip into chemistry for a glimpse at oxidation and the potential threat it can become to living cells. The encyclopedia tells us that if we could separate out the atoms, oxygen would make up half of the weight of all the rocks in the earth's crust, and eight-ninths of the weight of water. It makes up two-thirds of the weight of the human body.***77**

So much for being as light as air. We all know that oxygen is vital to life. In chemical terms "oxidation" is the process in which oxygen combines with an element or compound by means of sharing electrons.

The sun is a nuclear furnace; it radiates a great deal of its energy as visible light. In photosynthesis, plants capture particles (photons) of this high-energy light. Then in small steps, this energy is tamed and parceled out in the rich variety of chemical bonds that make up living substances. The energy is now carried in "excited" electrons, and the molecules made up of atoms which have the excited electrons are said to be oxidized; they can pass their newfound energy to other molecules through the process of oxidation.

Combustion is a familiar form of oxidation; we bring the sun's heat a little closer to home when we build a fire in our fireplace. This is also an example of rapid oxidation at work as oxygen combines with the material to be burned. The glow of firelight released in this process was at one time the sun's brilliant light and potent heat energy captured and stored in the tree which you are burning. Rusting demonstrates slow oxidation as iron and oxygen combine. Stale and rancid food is also the result of oxidation. Oxidation generates light and/or heat energy. You can see and feel its effects simply by standing in sunlight. Every living cell is dependent on oxidation as a means of power production.

Our body's germ killers (phagocytes) keep fired up with oxygen as well.***78** We breathe in oxygen and ingest plant products (either directly or indirectly) which have converted the sun's energy to carbohydrate, fat, and protein. Oxidation drives metabolism and generates heat energy from the food we have eaten. It releases carbon dioxide and water. You may have experienced the results of this process when you feel warmer after having eaten a meal. Thus the sun explodes with energy on a scale of exponential grandeur, and linked by photosynthesis this massive energy is captured in plant food where by means of oxidation on a microscopic scale a mechanism is provided for making the sun's life-promoting power available to us in the way best suited to fuel our trillions of

cells. We exhale carbon dioxide and water which plants recycle, thereby perpetuating this efficient and sublime interplay of energy.

However, you will recall that body processes are not random. According to Dr. Milton G. Crane, researcher at Weimar Institute, “Oxidation is meant to occur in a controlled sequence and in a specific setting within the cell chemistry. For oxygen to work in the body, nutrients need to be obtained from the plant products in such a way that they will not be oxidized or burned up at the wrong time or in the wrong place.”***79** Dr. Crane uses the analogy that just as it is possible to kindle a fire anywhere in your home to stay warm, a wood stove or fireplace is your best option for keeping the fire contained, controlled, and unable to do damage. Oxidation that is not controlled results in “free” or “toxic” radicals. It was reported in Executive Health, October 1993, that the discovery of free radicals is as important to human health as Louis Pasteur’s discovery of germs.

Free radicals are destabilized oxidized molecules which come in a variety of chemical forms. They can attack and destroy bystander molecules, setting off a chain reaction of cellular destruction which eventually assaults our DNA, causing normal cells to become cancerous. Without a way to neutralize these free radicals we would self-destruct.***80** They are believed to be important triggers of damage which leads to heart disease, and they are implicated in over one hundred other diseases.***81** They play a role in the aging process as well. Their discovery has changed the landscape of disease etiology.

We need a correct balance between our food energy sources and the regulators of oxidation. One of the areas where this balance is extremely critical is in fat intake. There is an affinity between these free radicals and certain bonding points in chains of fatty acids. A reaction between a free radical and a fatty acid is dangerous because of its potential to trigger a chain reaction.

You will recall that fatty acids combine to make up the various kinds of lipids which circulate throughout our body. The very presence of an oxidized lipid may interfere with cell membrane structure, the genes, and the cell chemistry which utilizes fatty acids.***82** All fat is a culprit in this process, particularly polyunsaturated vegetable oil. The Omega-3 molecule, highly touted as the beneficial fatty acid in fish oil, is in fact so unstable that it actively encourages the production of free radicals. Omega-3s are found in a more stable form in vegetables, fruit, and legumes.***83** Not only are dangerous chain reactions possible, but when oxygen combines with these fatty acids, it alters or modifies their normal structure. These oxy-fats then upset cell function in a number of ways. In terms of heart disease, there is a modified form of LDL created by this process, which the immune system regards as a foreign substance. Consequently, the immune system activates its removal cells (macrophages) to clear out this unwanted material. The macrophages become full of this oxidized LDL and must themselves become isolated and removed. These bloated, fat-filled cells contribute to plugging arterial walls. As you can

imagine, when the immune system is busy trying to cope with the overload of these toxic radicals, it has a diminished capacity to resist the infectious agents which could initiate other illnesses or cancer.***84**

Another lipoprotein which may result from excess or oxidized fat has been labeled lipoprotein-a. This fat globule has an enormous tendency to stick inside the walls of weakened vessels. A reevaluation of the Framingham heart study indicated a risk for heart disease from lipoprotein-a which was ten times greater than for high levels of LDL ("bad cholesterol").***85** Be prepared; it may be that LDLs, now lumped together under the term bad cholesterol, will one day be broken into sub-categories ranging from better to worse with these more recently discovered lipoproteins among them. They may become a part of standard blood lipid testing. With these renegade toxic radicals one thing leads to another, impairing the system at every step along the way.

So just how do vitamins intervene in this oxidation-toxic radical process? Beta-carotene, the precursor or parent of vitamin A, and vitamins C and E act as "antioxidants" because they protect other compounds from being oxidized by acting with oxygen themselves. They shoulder the attack and spare the cell any damage. Vitamins C and E can work together; when vitamin E sustains the attack, vitamin C is there to regenerate E so it can continue the defense.***86**

Fifty years ago a Canadian cardiologist reported that eighty percent of his heart disease patients had low blood levels of vitamin C. In 1954 another physician showed that vitamin C could reduce atherosclerotic deposits in his patients' arteries. In May 1992 the University of California, Los Angeles, reported on a study of eleven thousand Americans. They found that increasing the intake of vitamin C cut the death rate from heart disease nearly in half and lengthened life expectancy up to six years.***87** Dr. Matthias Rath, a leading expert in cardiovascular disease and nutrition, believes that there is a vital connection between vitamin C and the sticky, troublesome lipoprotein-a fat globule.***88** Research indicates that vitamin E also plays a protective role in the development of heart disease. According to researchers at the Harvard School of Public Health and Brigham and Women's Hospital in Boston, men and women who regularly take vitamin E supplements can cut the risk of heart attacks by about forty percent. Of the 120,000 men and women studied, those who supplemented daily for two years received the most benefit. (These supplements were ten times the current RDA for Vitamin E.) When taken in the small dietary amounts normally consumed, there was little protective benefit.***89** However, Vitamin E does continue to offer protection as an antioxidant at dietary levels. Vitamin E may be particularly helpful in preventing injurious free radical activity after heart attack or coronary-bypass surgery. Research done on rabbits at Toronto General Hospital showed seventy-eight percent less damage to heart tissue within two hours of a heart attack when the rabbits were injected with vitamin E.***90** Vitamin E also seems to boost the immune system in healthy

senior citizens and offers potential for combating a number of environmental pollutants from cigarette smoke to car exhaust.

Vitamin E appears to hold promise for patients with Parkinson's disease as well. It may be a factor in delaying the symptoms of tremor, rigidity and loss of balance.

According to a Canadian Study, vitamins C and E working together appear to reduce the risk of cataracts by fifty percent. It is speculated that if cataract development could be delayed by ten years, about half of cataract surgery could be eliminated.***91**

As an antioxidant, beta-carotene is a star performer. Doctors at Harvard Medical School, who have been following twenty-two thousand male physicians as part of a ten-year health study, found that men with a history of cardiac disease who were given beta-carotene supplements every other day suffered half as many heart attacks, strokes, and deaths as those given a placebo. A study is now underway to evaluate forty-five thousand postmenopausal women to determine if the treatment protects women in the same way. Scientists speculate that beta-carotene may help to decrease the impact of toxic radicals on blood lipids like LDL and lipoprotein-a, which are instrumental in the development of heart disease. Special interest has been directed toward the role of beta-carotene in combating cancer. In countries with a diet rich in beta-carotene, incidence of lung, colon, prostate, cervical, and breast cancer is low. That, of course, could be attributed to a number of factors, and there are some studies which indicate that beta-carotene is not the universal cure-all. However, a study at the University of Arizona Cancer Center found that three to six months of daily beta-carotene pills dramatically reduced precancerous mouth lesions in seventy percent of the patients.***92**

This marvelous nutrient may not flow from the elusive fountain of youth, but it does factor into the process of aging. According to Dr. Neal Barnard, "There is very little evidence of skin aging before age fifty. What passes for aging is mostly sun damage, or photoaging, which starts early in life."***93** It is those troublesome free radicals which are at work responding to the action of prolonged sun exposure on our skin. Remaining true to the harmonious exchange between plant and man, we find that what was meant to protect the plant from the sun was also designed to protect us. Free radicals form in plant leaves as a result of long hours of sun exposure just as they do in our skin. However, it is the beta-carotene in the plant leaf which removes these free radicals before they are able to inflict damage. That's why green leafy vegetables are generally an excellent source of beta-carotene. Fruit and vegetables which range in color from deep yellow to deep orange are also an excellent source of this nutrient since that is the natural pigment color of carotene. Deep green leaf color is the result of combining carotene with chlorophyll.

What beta-carotene does for the plant it will do for us. As far back as 1926 researchers were exploring the effects of beta-carotene on the skin, and

discovered that beta-carotene promoted tanning rather than burning. A diet rich in beta-carotene containing foods or supplements also increases tolerance to sun exposure in people who are extremely sensitive. You may remember all of the attention Retin-A received because of its ability to reverse the signs of aging skin. Retin-A and beta-carotene are part of the same family.***94** Please understand that does not mean that all you have to do is eat a carrot or spinach salad, and then you can spend as much time as you wish in the sun.

The role of antioxidants in disease prevention and treatment is a road still being paved. Currently, we are working with an incomplete picture and a diversity of reports. We need more intervention trials to reliably determine if direct links exist between antioxidants and cancer prevention, and just how this relationship works. Some studies use dosages of vitamin C and beta-carotene that would be possible to obtain from a healthy, conscientious dietary intake from fruit and vegetables. Vitamin E is generally supplemented at greater dosages than dietary equivalents. But many of the present studies utilize large supplemental dosages of these nutrients, and researchers are hesitant to recommend these dosages as part of one's daily routine, since long-term effects are unknown. We've learned much of what we know about the benefits of these nutrients as a result of eating whole foods. It may be that supplements offer dramatic results because most people are woefully short of eating the amount of fruit and vegetables necessary to keep these menacing toxic radical molecules from doing their damage. It may also be that these vitamins are more effective in terms of prevention and in ameliorating precancerous conditions than in short-circuiting a disease process already in motion.

Another factor implicated in the development of free or toxic radicals is iron. Iron is absolutely essential to carry oxygen in the blood, but it can also be a catalyst for damage caused by oxygen. "Just as iron and oxygen work together in the form of oxidation we recognize as rust, something similar happens within the body."***95** Dr. Randall B. Lauffer, a biochemist at Harvard University, indicates that the iron accumulated as one ages really has no place to go; it's unused and waiting to cause trouble. It is thought that this iron-catalyzed free radical damage may be the spark which sets off both heart disease and cancer, in addition to aggravating the aging process.***96**

At one time flesh food was considered superior for its contribution of more easily absorbed iron than that which comes from plants. Now science has discovered there is a reason why it is not to our advantage to have stockpiles of iron in our bodies. Iron is sprinkled throughout the plant kingdom, but in a form which prevents an unnecessary buildup. Related to this was the speculation that the reason women had fewer heart attacks prior to menopause was due to estrogen protection. Now it is thought that the fact that women lose iron each month as part of the menstrual cycle may actually be the protective characteristic. Women do not typically have a problem with iron accumulation

until after menstruation ceases. This excess disrupts the delicate interplay and balance of nutrients required for optimal health.

One thing we know for a certainty: each cell in the body has an entire antioxidant system that it uses to neutralize free radicals.***97** Since oxidation is a normal, ongoing necessity to fire the metabolism of our food and produce the heat energy which powers the body system, the potential for toxic radical activity is omnipresent. Vitamins and other phyto (plant) chemicals are continually at work to offset these reactions. Therefore it is imperative that we have an abundant supply of these substances circulating throughout our body at all times. This does not necessarily mean taking supplements. Vitamins have become a three-billion-dollar-per-year industry. People seem to think that they need extra protection, or that if a little is good a lot is better. We forget that body chemistry takes place on a microscopic scale and that our total vitamin needs are only about one ounce for every 150 pounds of food we eat. ***98** We also seem to be a nation of pill-poppers, but supplements cannot bottle the full complement of chemicals contained in the plant itself, nor do they maintain the proportion or balance with which nature packaged those nutrients in the plant. Not to mention that pills simply cannot mimic the benefits of fiber which come with whole plant foods. Perhaps what holds true for great masterpieces of art also holds true for the artistry of nature's plant creations—a copy is never worth the value of an original.

Lucid arguments can be made on both sides of the supplement vs. non-supplement controversy. I recognize that depleted, overworked or eroded soils can affect mineral availability to the plant, and one could certainly take issue with the standard which determines our recommended daily allowances for these nutrients, but the bottom line is that we simply need to eat far more plant foods which contain these protective vitamins and phytochemicals, and cut way back on fat. The National Center for Health Statistics reports that a meager nine percent of adults consume five servings of fruits and vegetables a day, and that's a minimum amount, according to the new food pyramid recommendations. It should also be clear that our eating habits have entangled us in the grip of a fat-overload fiasco which pulsates with a disease potential that threatens our very lives. It has been estimated that diet accounts for thirty-five to sixty percent of all cancers, and that tobacco is responsible for another thirty percent; between the two, sixty-five to ninety percent of cancers could be avoided.***99**

Why do we do this to ourselves? Yet nature strives with us. The antioxidants, vitamins C, E, and beta-carotene, point out that in spite of this fat fiasco, the abuses and toxins to which we expose our bodies, and the numerous ways in which we work at odds with nature rather than happily cooperating, the body is unrelenting in its attempt to counter the damage. We have looked at only one dimension in which vitamins C, E, and beta-carotene, the parent of vitamin A, work to protect us. Let's turn our attention to their many other functions.

VITAMIN C

This vitamin is well known to all. Its name, *ascorbic acid*, means no scurvy acid, stemming from the discovery that citrus fruits such as oranges, lemons, and limes prevented death from scurvy during the long ocean voyages in which stores of fruit and vegetables were depleted well before the journey's end. ***100** Vitamin C is water-soluble, and is thereby susceptible to leaching out of food during the cooking process. Less time in cooking and using less water will assist in preserving the vitamin content of the food. One must also be mindful to keep containers closed tightly when storing vitamin C products, such as orange juice, in the refrigerator. If lids are left open or not used at all, the vitamin C will oxidize away. There is an endless controversy regarding the benefits to be gained from megadose supplementation of this vitamin. Supplementation is a personal choice, but should never be a substitute for a healthy diet. In general, toxicity due to an overdose does not develop, because once the cells are saturated with the vitamin, the excess is excreted as waste. Megadosing on water-soluble vitamins could result in pretty expensive urine. Cigarette smoking interferes with the use of vitamin C in the body. Extra vitamin C can normalize blood levels but cannot protect against the damage caused by smoking.***101**

VITAMIN C FUNCTIONS

Vitamin C***102** is necessary for the formation of collagen, a protein substance used to build connective tissue in the body. Collagen provides the supporting structure for bones, teeth, skin and tendons. It is also necessary for strong artery walls. If lack of vitamin C leads to a weakening of these artery walls, a domino effect may be created, contributing to heart disease.

Vitamin C is related to the production of thyroxin, a hormone which regulates body temperature and metabolic rate.

It plays a role in combating the oxidation of iron and therefore is also necessary for the absorption of iron. It is advisable to use orange juice (or some other vitamin-C-containing fruit or juice) with cereal rather than milk for children or adults who may have iron-deficiency anemia. That will absorb the iron from the grains more efficiently.

Vitamin C guards against infection, thereby playing a role in immunity.

Vitamin C is involved in the release of stress hormones.

FOOD SOURCES OF VITAMIN C

- All citrus fruits: oranges, grapefruit, lemons, and limes
- Bell peppers, both red and green; hot green chilis are also high if you can eat them uncooked.
- Broccoli, Brussels sprouts, cauliflower
- Cantaloupe (1/2 melon), papaya, kiwi, strawberries, mangoes, tomatoes, blackberries, raspberries, watermelon, pineapple

- Collards, kale, mustard greens, turnip greens, spinach, cabbage, Swiss chard, asparagus, and potatoes

A serving is generally considered to be 1/2 to 1 cup; 1 cup cooked of the leafy green vegetables. The food listed at the beginning of each grouping contains the most vitamin C per serving.

BETA-CAROTENE AND VITAMIN A

Since beta-carotene and vitamin A share a close family relationship, their duties sometimes overlap. Beta-carotene is made by the plant; within the human body it is converted into three kinds of vitamin A which are used in numerous ways. However, it is betacarotene that has smitten researchers with its potential as an antioxidant and in strengthening immunity. The body's immune system is designed to maintain our health and ward off unwanted invaders. We have white blood cells specially equipped to destroy cancer cells and bacteria before they have a chance to cause damage. The food we put into our mouths equips these cells to effectively and efficiently carry forward their work. They relish beta-carotene-rich foods and a low fat diet. When properly fed, the percentage of these killer cells significantly increases. Betacarotene counteracts the reduction of these killer cells, and the consequent loss of immune strength which naturally accompanies the aging process.***103**

Vitamin A also contributes to this process, but does not have the same immune-boosting power as beta-carotene. The amount of this nutrient in two large carrots is enough to bolster this process.***104** The German Cancer Research Center in Heidelberg has been examining vegetarians and comparing them to nonvegetarians since 1978. They have discovered that vegetarians have the strongest immune systems. When comparing the white cells' ability to destroy cancer cells in both groups, it was found that vegetarians had more than double the ability of their nonvegetarian counterparts to destroy cancer cells. The study also revealed more betacarotene in the blood samples of the vegetarians. The immune benefits of a vegetarian diet are due to a higher vitamin intake from plant sources and a lower intake of fat.***105**

It should be mentioned that blood studies show that low concentrations of beta-carotene in the blood are consistently associated with the development of lung cancer. This may not be due to the influence of beta-carotene alone, but could be related to constituents of other fruit and vegetables yet to be investigated.***106** Both beta-carotene and vitamin A are fat-soluble. Beta-carotene, which consists of two molecules of vitamin A, is split and converted to vitamin A by the body as needed.

Currently there is no known level of toxicity for beta-carotene, but it may turn the skin bright yellow if taken in large enough quantities because it builds up in the fat stores just under the skin. Overdosing on vitamin A may cause liver damage, since it is stored in both the liver and body fat. Beta-carotene is only one of a number of carotenoids which nature deposits in fruit and vegetables.

Reliance on supplements may actually short-change us. At present beta-carotene is familiar, thus readily available in supplement form—but what about the benefits to be had from the rest of this chemical family? Vitamin A is one of the most versatile vitamins. It is needed everywhere. Here is a brief list of its functions:

VITAMIN A FUNCTIONS

Vitamin A***107** plays a vital role in vision, and in being able to see at night. In response to light, vitamin A is part of the initiating signal which conveys the stimulus of sight to the brain's optic center. In this process a little vitamin A is destroyed each time, thus we must keep our blood supply replenished to support this ongoing mechanism. It also keeps our cornea, the hard, clear membranous window of the eye, healthy.

Vitamin A contributes to the health of our skin and all the protective linings throughout the body—from lungs to urinary tract. This is the body's first line of defense against environmental insult. It also plays a role in immunity and in fighting infections.

Vitamin A is necessary for growth of bones and teeth.

It acts somewhat like a hormone in regulating storage, release and conversion of various substances, and is involved in reproduction.

FOOD SOURCES OF BETA-CAROTENE WHICH CAN BE CONVERTED TO VITAMIN A

All vegetables with dark green leaves—generally the darker the leaves the better source it is of beta-carotene. Iceberg lettuce is not a good source. All fruits and vegetables which are deep yellow to deep orange in color. Notable exceptions are oranges, corn, and green beans.

- Sweet potatoes, carrots (1 medium carrot), pumpkin, squash, red peppers
    - Dandelion greens, collard greens, turnip greens, spinach, kale, Swiss chard, bok choy, mustard greens, beet greens, arugula, green leafy cabbage, romaine lettuce, endive
- Cantaloupe, apricots, mangoes, persimmon, guava, watermelon, nectarines, papaya, peaches (dried apricots and peaches are rich sources but high in calories)
- Broccoli, tomatoes including juice and sauce, Brussels sprouts, green peas, asparagus
- Beta-carotene herbs: basil, coriander, dill, fennel leaves, mint, parsley, and rosemary

Serving size is generally 1/2 cup to 1 cup cooked (except herbs).

A reminder that we should value the entire family of carotenoids was reported in the June 1994 issue of Environmental Nutrition. Beta-carotene is only one of over five hundred different carotenoids. Many others of this family

have also been shown to offer protection from cancer and to strengthen the immune system. They not only act as antioxidants, but are thought to stop cancer at its earliest stages. Fresh fruits and vegetables are the best way to benefit from the entire scope of the carotenoid family. It's been suggested that taking large amounts of only one carotenoid, such as beta-carotene, in supplements rather than from food, may impair the absorption of other important carotenoids, short-circuiting their health advantages.

VITAMIN E

A deficiency of vitamin E is quite rare. There are three main reasons why this is true. (1) The vitamin is so widespread in food that it would be very difficult to create a deficit; (2) because vitamin E is fat soluble, the body efficiently stores it in body fat and has continuous, ample reserves; and (3) the body cells may recycle their working supply of vitamin E. Cases of toxicity are also uncommon. It is being put to constant use in the body as an antioxidant.

VITAMIN E FUNCTIONS

The primary role of Vitamin E***108** is that of antioxidant, acting like a bodyguard for other substances. By being destroyed itself, it protects polyunsaturated fats and other fat-soluble substances like vitamin A, from being oxidized. It serves as a main defender against the chain reactions of damage which oxidation can precipitate.

It exerts an especially important influence as an antioxidant in the lungs where cells are exposed to high oxygen concentrations which could destroy their membranes. It also protects the membranes of the red blood cells as they transport oxygen from the lungs to other tissues.

Vitamin E protects the white blood cells which guard against disease and may also play a role in immunity.

Normal nerve development depends on this nutrient.

Researchers have consistently found a link between vitamin E and a lower risk of heart disease. However, the dosages used in these studies have been high, and evidence is not yet strong enough to recommend supplementation at that level.

FOOD SOURCES

Vitamin E is found in vegetable oils and products made from them, such as margarine, mayonnaise and salad dressing.

- Nuts, seeds (especially sunflower) and legumes (especially soybeans)
- Wheat germ and whole grain products
- Green leafy vegetables, corn, avocados, sweet potatoes, and mangoes

Keep your eyes open for another obscure leafy green known as "purslane." It is a wild, vine-like, green leaf plant that grows like a weed and is often overlooked for its supreme nutritional value. It contains more vitamins A, C, and E than most of the other green leafy vegetables, and what makes it unique is that it is also a rich source of the beneficial omega-3 fatty acid normally associated with fish. It can be eaten in salads or cooked like other greens. It is available in some adventurous supermarkets.

As you look over the lists of food sources for these three antioxidant vitamins, it's evident that some foods contain all three of these nutrients, and many contain two of the three. It should not be difficult to find food choices on each list which are both readily available and suitable to individual taste preferences. These nutrients are scattered throughout the plant kingdom—fruit, vegetables, grains, legumes, nuts and seeds. I have listed those foods where these particular vitamins are concentrated, but many other plant foods contain these nutrients in lesser amounts. When we eat abundantly from the plants which nature supplies, we are covered with her mantle of protection.

I must reiterate that the way nature packages food is not accidental. There is a balance among nutrients in the orange, the apple, the broccoli floret, the soybean and the almond which facilitates optimal usage in our bodies. Consider the studies which have been done on nuts—a good source of vitamin E. Nuts are high in unsaturated fat and calories, and one might assume that they would increase cholesterol or LDL levels in our bodies. But that is not what researchers are discovering. An update on research being done at Loma Linda University, reported in Environmental Nutrition, July 1993 showed that "people who ate a handful of nuts (peanuts, almonds, or walnuts) five or more times a week suffered fewer deaths from heart disease than those who ate nuts less often." The same researchers had previously focused their attention on walnuts and found that healthy men who ate twenty whole walnuts per day "lowered" both their cholesterol and LDL levels. It must be pointed out that their general diet was low in fat and even with the increased fat coming from the nuts, their total fat intake did not exceed the thirty percent of total calorie intake which is currently being recommended to lower risk of heart disease and certain cancers.

Another small study reported in *Executive 's Health*, February 1993 demonstrated the same effect from almonds. Almonds were chosen because like olives, they contain mostly monounsaturated fat. The participants in this study, which was conducted at the YMCA Cardiac Rehabilitation Unit in Palo Alto, California, had seventy-five almonds added to their diet daily. They also used almond oil to replace salad dressing, butter, and other fats. They ate primarily grains, beans, vegetables, fruit, and low-fat milk products. At the end of nine weeks, both cholesterol and LDL had dropped without lowering the good HDL—all of this without anyone gaining weight. This was a small sample which cannot be used as conclusive evidence upon which to make a case, and one should definitely not infer that nuts can be eaten ad libitum. But it does

underscore that dietary habits based on plant foods have clear advantages over those based on animal products. High-fat plant sources do not have the negative repercussions associated with animal fat. In light of the antioxidants, it is of interest that nuts, a good source of vitamin E, effectively illustrate that nature does not package fat in food without protective substances to go along with it.

One of the reasons polyunsaturated oils from plants pose oxidation problems may be due in part to the way they have been reconfigured in the refining process. The way nutrients are arranged in the whole plant food is almost the opposite of what we do to the food by means of refinement. This undoubtedly influences our body's response to it. Oil as it is in corn, olives, nuts, grains, or seeds is encapsulated. It is contained within an outer coating of cellulose fiber or protein which protects it from oxidation. Corn can be stored for up to a thousand years before it becomes so decomposed by oxidation that it will not grow.***109** That has been demonstrated in grains of corn enclosed with Peruvian mummies. Yet corn flour turns rancid within a few weeks after being milled to meal. That is oxidation at work. When vegetable oils are refined they are extracted from their protected compartments. This process entails the loss of vitamins, minerals, lecithin, free fatty acids, a multitude of sterols, and subjects the oil to rancidity as oxidation has its way. We look upon this "purification" as though we had removed pollutants, and use these oils in just the reverse of nature's design within the food.***110** Could this processing make these oils more susceptible to oxidation within our bodies as well? It is little wonder that we must contend with the consequences of these alterations. It strikes me as even more remarkable that we are afforded protection in spite of our presumption and incredulity.

This concludes our promenade down the antioxidant aisle of nature's pharmacy; let's continue with a quick rundown of what nature makes available for us by means of the B vitamins. We touched upon these briefly in chapter 1. We have seen that B vitamins contribute to a healthy state of mind. Vitamins and minerals are important in the composition and function of neuro-transmitters—the body's chemical messenger molecules which relay information from one nerve cell to another leading to and from the brain, and from one part of the body to another. The brain also needs electrically charged minerals to help transmit its electrical impulses. These vitamins and minerals work without ceasing on several fronts. Nature has been generous in providing all that we need, but we must know where to find it.

THE B VITAMINS—"B" ALIVE

We mentioned the B vitamins and their important role as coenzymes m chapter one. People sometimes think that B vitamins can give them more energy. Actually, they do not contain energy themselves, but they facilitate the release of energy from our food. They contribute to the work of every cell and are key players in the nervous system. They are water-soluble, which means that

an excess generally doesn't build up in the body but is eliminated in the urine. Though exceptions do occur, exposure to water in cooking and cleaning will leach some of these vitamins out of food; be careful not to overcook. We will glance at the primary responsibilities of each B vitamin.

Thiamin: Sometimes called the "good humor" vitamin, it is necessary for energy metabolism and nervous system responses—remember the women (in chapter 1) whose personalities were altered by a deficit of this vitamin; it is also important for the response between nerve cells and muscle. Alcohol causes excretion of thiamin in the urine.***111**

Food Sources: Green leafy vegetables, whole grain breads and cereals, legumes, and nuts

Riboflavin: Necessary for energy metabolism of all body cells, normal vision and healthy skin.

Food Sources: Green leafy vegetables, whole grain breads and cereals, milk products

Niacin: Also necessary for energy metabolism and healthy skin, contributes to health of nervous and digestive systems. Niacin can be converted in the body from an amino acid, tryptophan, which is present in almost all proteins.

Food Sources: Whole grain and enriched breads and cereals, legumes, nuts, milk products, all protein-containing foods. Sometimes it is prescribed in large dosages by physicians as a measure against atherosclerosis.

Biotin and Pantothenic Acid: Both are necessary for energy metabolism. Pantothenic acid participates in more than one hundred different steps in the synthesis of lipids, neurotransmitters, steroid hormones, and hemoglobin. It also acts to stimulate growth.

Food Sources: Both are widespread in almost all food

Vitamin B_6: Assists in the process of converting tryptophan to niacin as well as converting one kind of amino acid (protein building blocks) into another. It contributes to the regulation of blood glucose and plays a role in immune function. Women have taken it to combat PMS symptoms. It was by means of the megadoses taken for this reason that it was discovered that too much B_6 could create toxic symptoms after as little as two months. Moderate amounts taken as supplements for this reason also resulted in toxic symptoms after about five years. To date, no conclusive studies have indicated vitamin B_6 as a measure to alleviate PMS symptoms.

Food Sources: Potatoes, watermelon, bananas, leafy green vegetables, legumes.

Vitamin 12 and **Folate** (also called folacin or folic acid): These two B vitamins are partners m many body processes. They both work to make red blood cells. Vitamin B_{12} helps maintain the sheath that protects nerve fibers. Folate is thought to protect the genetic material of cells and is required to make new cells. It is especially vital during pregnancy when cell multiplication is very rapid. It plays an important role in the prevention of certain birth defects, such as anencephaly and neural tube defects. There is evidence that woman chronically deficient in folate have a significantly higher risk of developing cervical cancer.

Food Sources: Folate comes from the word foliage; thus, as is the case with most B vitamins, green leafy vegetables are an excellent source. Fresh fruit and vegetables are the best sources since folate is easily destroyed by cooking. Legumes and seeds are also good sources.

Vitamin B_{12} is a product of bacterial action and is found primarily in foods of animal origin. B_{12} is added to miscellaneous products including some cereals, soy milk, vegetable protein substitutes and brewer's yeast. It can also be found in tempeh. One needs to read labels. A pure vegan vegetarian may want to supplement with B_{12}. The body can store B_{12} from three to five years. Deficiencies may take several years to develop. Adding B_{12} to specific products such as brewer's yeast is not a consistent practice. However, brewer's yeast is an excellent source of thiamin, niacin, riboflavin and folate. It is also high in protein and contains moderate amounts of iron, magnesium, phosphorus and potassium. A heading in the April 1994 issue of Environmental Nutrition referred to brewer's yeast as a B-vitamin bonanza.

(B vitamin functions and food sources adapted from Nutrition Concepts and Controversies, Sixth ed., by Frances Sizer and Eleanor Whitney.)

A study reported in the Tufts University Diet and Nutrition Letter, February 1994 indicates that low levels of folate, B_6 and B_{12} are related to an increase of homocysteine in the blood. Evidence is accumulating that an increase of this blood chemical may be linked to clogged arteries. People with high levels of homocysteine in their blood have a three to four times greater risk for heart attack than those who have normal levels. People with these high homocysteine levels also tend to consume less folate, B_6 and B_{12}. Low consumption of these nutrients was found to be true for three out of ten people over age sixty-five. The B vitamins help convert homocysteine (a protein building block) into usable amino acids. This has led to an increased concern that older people especially need to be made aware of their need for these important B vitamins.

Do you capture this cascading rhythm of how one interaction leads to and triggers another? Every atom contributes to the orchestration of this masterpiece of composition. I hope this majestic harmony of vitamin interaction is playing loud and clear—plants are the royal suite of foods. It should be obvious that green leafy vegetables are as valuable as emeralds to our health. Thus far the vitamins from our plant pharmacy provide protection from the damages of

oxidation; they preserve priceless DNA, and afford resistance to the onslaught of major chronic diseases. They play a key role in releasing energy from our food, keeping our skin, hair, bones and teeth healthy, and supporting the proper function of all the body systems from the nervous system to the digestive system. We still have a few more aisles to explore—minerals and phyto-chemicals. Minerals come next.

MINERALS—GEMS FROM THE EARTH'S CRUST

We hear much more about vitamins than minerals, but minerals are certainly no less important to our health, and are critical for even basic survival. Science has been focusing more attention on their potential link to our protection from major chronic diseases like high blood pressure, osteoporosis, cardiovascular disease and cancer with promising results. As mentioned earlier, too much iron may play a crucial role in oxidation. Researchers in Finland studied about two thousand healthy men for three years. They tracked twenty risk factors for heart disease, and at the end of the study the risk of heart disease was twice as great for those men with high blood levels of iron. The only other risk factor more significant was smoking.***112** We have also mentioned the contributing role that a little known mineral, boron, may play in offering protection from osteoporosis. Certainly calcium is at the forefront of osteoporosis prevention. There are more than sixty minerals in the body which account for about four percent of our body weight. We will take only a glance at a handful of them.

There are twenty-two minerals considered to be essential. Seven are major minerals because they are present in quantities larger than a teaspoonful in our body; the other fourteen are termed trace minerals because they are needed in such minuscule amounts. However, the tiny amounts are not indicative of their relative importance to health. The .00004 percent of your body which is iodine is just as vital for survival as the 1.5 to 2 percent which is calcium.***113**

Minerals are necessary to maintain fluid balance in the body. About forty percent of the body's water weight is inside the cells, and about fifteen percent bathes the outside of the cells. The rest fills our blood vessels. "Special provisions are needed to ensure that cells do not collapse when water leaves them or swell up when too much water enters them. The cells cannot pump water across their membranes because water slips in and out freely. They can, however, pump minerals across their membranes. The major minerals form salts that dissolve in the body fluids; the cells direct where the salts go; and this determines where the fluids flow, because water follows salt."***114**

Unlike pure water, which is a poor conductor of electricity, when mineral salts dissolve in water they separate into single, electrically charged particles called ions, which carry electrical current. These ions are known as electrolytes; and it's electrolytes which the body uses to move its fluids around. An electrolyte-fluid balance is necessary to make certain that each compartment of the body contains the proper amount and kind of fluid. Minerals also assist in

managing the crucial acid-base balance. Since our bodies operate on chemical and electrical impulse, the value of minerals cannot be overestimated.

Minerals in food are indestructible, but when food is boiled some of the minerals may dissolve into the water. Many people recycle this cooking water and use it in soups, sauces, beverages, or dressings. Minerals can also be lost in the refining process. Supplementation of minerals is not advised. It is not the case that if a little is good, a lot is better. The interactions among vitamins, minerals, other nutrients and substances is too complex to disturb the balance and synergy. What we understand about these interactions compared to what there is yet to be discovered, is about equivalent to a bucket of rock from the Grand Canyon. We do know that there are billions and billions of iron atoms in a teaspoon of iron, and by the marvels of physiological processes, our body is able to achieve colossal results with atoms equivalent to less than a speck. So let's begin with the ways major minerals protect our health.

Calcium is the most abundant mineral in the body. Nearly ninety-nine percent of it is stored in the bones, where it not only serves to formulate bone structure but functions as a bank which deposits calcium into the body fluids at the very slightest indication that blood calcium levels have dropped. It not only builds bone and teeth, but maintains bone density and strength. Once bone is built it is not static; minerals of the bone are in constant flux, reforming and dismantling. The other one percent travels in the fluids that bathe and fill our cells. It's a minute amount, but here is what it does:

It regulates the transport of ions across cell membranes and is particularly important in nerve transmission.

It helps maintain normal blood pressure.

It is essential for muscle contraction and therefore for the heartbeat.

It is involved in the secretion of hormones, digestive enzymes, and neurotransmitters.

It plays an essential role in the clotting of blood.

To be protected against osteoporosis in later years it is necessary to build solid bones during childhood and young adulthood up until about age twenty-four. That is the time when most bone growth takes place. After about age forty, bones begin to lose density regardless of calcium intake. It is done quietly without any overt indication. One can live on inadequate dietary amounts of calcium for years with no noticeable symptoms. It is thought that enough calcium during the young years will ensure that the skeleton starts out with enough mass to minimize bone losses later in life. Calcium deficiencies are suspected to be widespread due to losses in adulthood. However, you will recall as mentioned earlier, that the body's use of calcium is not reliant on dietary calcium alone, but on the interaction among several nutrients, including potassium, boron, magnesium, phosphate, protein, salt, and others.

- **Food Sources**: Green leafy vegetables, such as broccoli, beet greens, mustard greens, kale, collards, watercress, and parsley. (Swiss chard, spinach, and rhubarb are also high in calcium, but they contain calcium binders which inhibit its availability. They are depositories of many other nutrients, but not as usable calcium sources.)
- Legumes and almonds
- Some processed foods such as tofu, canned tomatoes, stone-ground or self-rising flour, and blackstrap molasses also are good sources because calcium was used in the processing.
  - Calcium-enriched orange juice and soy milk are good sources.
- Milk and milk products

Phosphorus is the second most abundant mineral in the body. About eighty-five percent of it is found combined with calcium in bones and teeth. The concentration of phosphorus in the blood is less than half that of calcium. Deficiencies are unknown. It is a part of each cell’s genetic material, therefore essential for growth and renewal of tissues. It is essential for energy production and to maintain the acid-base balance. It is also necessary to form cell membranes.

Food Sources: Almost all foods. Legumes, nuts, peas, dairy products.

Magnesium: Over half of the less than two ounces of magnesium in a 130-pound person is in the bones. Magnesium is critical to the operation of hundreds of enzymes and directly affects the metabolism of potassium, calcium, and vitamin D. It plays an integral role in nearly three hundred body functions. It aids in bone growth, basic metabolic functions, and the functioning of nerves and muscles, including the regulation of normal heart rhythm. Low intake has been linked to high blood pressure, heart-rhythm abnormalities, and heart attack. People whose drinking water has a high magnesium content experience a lower incidence of sudden death from heart attack. Magnesium is easily washed and peeled away from foods during processing, so fresh or slightly processed foods are your best choices.

Food Sources: Nuts, legumes, whole grains, wheat bran, dark green vegetables, bananas, apricots

Potassium is the principal positively-charged ion inside body cells. It is vital for muscle contraction, nerve impulses, and function of heart and kidneys. It is necessary for regulation of the fluid-electrolyte balance within cells and in regulating blood pressure. There’s some evidence that diets high in potassium-rich fruits and vegetables reduce the risk of hypertension and stroke.

Food Sources: Fresh foods of all kinds. Fruit, vegetables, whole grains, legumes

Sodium is the chief ion used to maintain the volume of fluid outside the cells. Sodium attracts water. It is essential to muscle contraction and nerve transmission. The connection between sodium and high blood pressure in salt-sensitive people is well known. This may not be due solely to an increased sodium intake. As you can see from the previous descriptions, calcium, potassium, and magnesium may also factor into the blood pressure equation. Diets rarely lack enough sodium.

Food Sources: Almost all processed food, salt, and soy sauce

Iron: Every living cell, whether plant or animal, contains iron. Most of it in the body is a component of the proteins: hemoglobin in red blood cells and myoglobin in muscle cells. Oxygen transport throughout the body is reliant on these red blood cell carriers. Red blood cells live only about three to four months, but when they die the spleen and liver break them down and save the iron. It is then shipped back to the bone marrow to be recycled. Iron also helps many enzymes in energy pathways to use oxygen, and is needed to make new cells, amino acids, hormones, and neurotransmitters. Since iron is widespread in foods, a deficiency is generally due to malnutrition or a high consumption of the wrong kinds of foods—those high in sugar and fat with little nutrient value. Generally, women need to be more aware of their iron intake than men because of the monthly loss during the menstrual cycle. We have already mentioned the potential hazards of too much iron in the body as it relates to the production of free radicals by means of oxidation. More work needs to be done to clarify the association. Tea, coffee, the calcium and phosphorus in milk, and compounds (phytates) present in some plant foods impair iron absorption. Combining an iron food and a vitamin C food enhances absorption.

Food Sources: Legumes, peas, nuts, dried fruits, leafy green vegetables, enriched pasta and bread, fortified cereals. Cooking in iron pots adds iron, especially to acidic foods.

Chromium is important in the metabolism of carbohydrates and fats. It works closely with the hormone insulin, facilitating the uptake of glucose into cells and the release of its energy. Thus both the regulation of glucose and the action of insulin are impaired by a dietary deficiency. Some studies have shown that supplements of a specific form of chromium called chromium picolinate encourage the building of muscle. That makes it a hit with body builders. However, other studies have found the chromium picolinate supplement to be ineffective. Although chromium is available in a variety of foods, food processing results in losses. A diet high in simple sugars also depletes chromium in the body.

Food Sources: Whole grains, nuts, broccoli, brewer’s yeast, wheat germ, fortified cereals, prunes, peanuts, peas

Copper helps in the formation of red blood cells and assists in keeping bones, blood vessels, nerves, and immune system healthy. Studies indicate that copper deficiencies may be related to anemia, arthritis, heart disease, high cholesterol, heart irregularities, and high blood sugar. It is still under study for the role it may play in heart disease. Megadoses of vitamin C interfere with copper absorption.

Food Sources: Whole grains, legumes, nuts, seeds, mushrooms, tomatoes, bananas, grapes, potatoes and dried fruits

Selenium has gained attention for its association with vitamin E in combating the damages of oxidation. It can stand in for vitamin E in some of its antioxidant activities, thereby sparing vitamin E. It is a factor in the regulation of metabolic rate and is needed for proper immune response. Its relationship to vitamin E as an antioxidant has made it the subject of study in terms of offering protection against cancer. Deficiencies are rare as long as our farming soil contains enough selenium.

Food Sources: Brazil nuts, garlic, grains, and vegetables; amount depends on soil conditions.

Zinc works with proteins in every organ as a helper for more than one hundred enzymes. It participates with these enzymes to perform the following functions:

Makes parts of cells' genetic material
Makes heme in hemoglobin
Helps the pancreas with its digestive functions
Helps metabolize carbohydrate, protein, and fat
Liberates vitamin A from storage in the liver
Disposes of damaging free radicals
Zinc also affects behavior and learning.

It assists in immune functions, is essential to wound healing, sperm production, fetal development, and growth in children. It contributes to taste and vision.

Food Sources: Variety is important. Grains (especially breads made with yeast), brewer's yeast, and wheat germ. Legumes, nuts, tofu, peas, yogurt, green leafy and other vegetables.

(Sources for Mineral Section: Nutrition Concepts and Controversies, Sixth Ed., by Frances Sizer and Eleanor Whitney; The University of California at Berkeley Wellness Letter, August 1992.)

From ashes to ashes and dust to dust; it is minerals alone which remain when the light of life is extinguished. Just how did these sixty-plus minerals become a part of us to begin with? And how is it that plants repeat this theme of life

springing from dust as they mine minerals from the earth and capture energy from the sun to place these jewels of life within us? If vitamins are like diamonds, minerals are like gold. Who could possibly say which substance is most important for our health and well-being? From the calcium crystal which eventually becomes a long, sturdy bone to the potency of the antioxidant trio of vitamins which work to defend us from the heavyweights of heart disease and cancer, we see evidence of nature's providence.

But, as valuable as these are to our health, the grand finale awaits as we enter the last aisle of our pharmacy—phytochemicals ("phyto" comes from the Greek word for plant). These plant chemicals are beyond the imagination of any pharmacist. Some chemicals act as natural pesticides in the plant to ward off insects and animal predators. Others regulate normal growth and development of the plant and guard against infection. Many exist in the plant to offer it protection while it soaks up the sun's energy from sunrise to sunset, day after day, thus enabling it to pass that power on to us. They are just beginning to be understood. Their knowledge may one day dwarf even the antioxidants in the myriad ways they assist us in preventing disease.

PHYTOCHEMICALS—WHAT MORE COULD ONE ASK?

I will begin by listing some of the headings making news in recent health publications regarding the nutrient value of plants and the continual unfolding of beneficial substances contained within. Much of the research at this juncture is being done in test tubes and on animals, which gives us clues to the impact of these substances on our health, but cannot become conclusive until we can equate the research to human studies.

CRUCIFEROUS = SPLENDIFEROUS

Broccoli and its relatives are a nutritional powerhouse. They are known as cruciferous because their flowers are cross-shaped. One cup of cooked broccoli supplies half of a day's supply of vitamin A (in the form of beta-carotene), twice the requirement for vitamin C (more than a glass of orange juice), six percent of niacin, nine percent of calcium, twelve percent of phosphorus, ten percent of iron, twenty percent of daily fiber needs, five grams of protein, some potassium, and all this for only forty-five calories. The phytochemicals it contains have less than memorable names: indoles, isothiocyanates, and others. One of these isothiocyanates, known as sulforaphane, has captured attention for its role in cancer prevention. In the test tube it was able to protect cells against cancer-causing agents, and in a study done at Johns Hopkins University School of Medicine it was shown to be protective against mammary cancers in laboratory animals. Studies also showed that humans who eat large amounts of cruciferous vegetables were at reduced risk of various kinds of cancer. It is suspected that it is the combination of beta-carotene, indoles and isothiocyanates, as well as other substances, which are working to offer this protection. Other members of this

family, cabbage, kale, cauliflower, and brussels sprouts, are high in nutritional value, but none quite the equivalent of broccoli.

Reported in the University of California at Berkeley *Wellness Letter*, July 1994, Volume 10, Issue 10.

Newsweek, April 25, 1994 commented further on how the sulforaphane testing being done at Johns Hopkins may work. Within hours after being eaten, sulforaphane enters the blood stream. As it circulates it triggers one of the body's defense systems; it activates a group of enzymes which burst into action attaching the carcinogen which may have come from food, drink, air, or smoke, to a molecule which whisks it out of the cell.

This same April 1994 issue of *Newsweek* hailed the discovery of phytochemicals as its centerpiece article and went on to discuss the following benefits:

Another isothiocyanate chemical found in cabbage and turnips, called PEITC for short, inhibits lung cancer by breaking carcinogens into fragments before they can bind to a cell's DNA.

A phytochemical in strawberries, grapes and raspberries, called ellagic acid, also neutralizes carcinogens before they can invade DNA.

Two of the phytochemicals in tomatoes, p-coumaric acid and chlorogenic acid, are thought to combat cancer by disrupting the making of nitrosamines, which can work to turn normal cells cancerous. These two chemicals are also found in green peppers, pineapples, strawberries, and carrots to name a few.

Indole-3-carbinol, another chemical in the cruciferous family, cuts the risk of breast cancer by triggering enzymes which act to break down estrogen into a harmless form rather than its cancer causing form.

Onion and garlic contain allylic sulfide, which works on enzymes to detoxify carcinogens.

Capsaicin in hot peppers keeps toxic molecules from attaching to DNA and thereby initiating cancer, as does another phytochemical found in turmeric and cumin.

Almost every fruit and vegetable, from berries to yams, citrus, and cucumbers contains flavonoids, another antioxidant and anti-carcinogen.

The December 1993 issue of *Environmental Nutrition* reported on a study from the Netherlands where researchers evaluated 805 men aged sixty-five to eighty-four regarding their diet and other risk factors for heart attack. The group of men who consumed the highest amounts of flavonoids suffered less than half the number of fatal heart attacks as the men who consumed the lowest amounts. Tea, onions, and apples were the chief sources of flavonoids in their diets.

Another report in *Executive Health*, January 1993, had this lead-in title:

Plant Flavonoids—Can They Heal Us?

This article indicated that flavonoids are often found in the same foods which are high in vitamin C. Albert Szent-Gyorgyi, who won the Nobel Prize in 1937 for his work on vitamin C, also reported on the isolation of citrin, a flavonoid from lemon juice which had remarkable effects on blood vessels. This work led to further research on flavonoids. Flavonoids are what give color to flowers, leaves, and stems. At least five hundred are presently known. From initial studies it was learned that flavonoids appear to have a role in the prevention of heart disease. Not only do they play a role in keeping blood vessels from getting blocked, but they help to lower serum lipid and cholesterol levels. Other plant flavonoids are thought to produce anti-allergy, anti-inflammatory, and anti-cancer effects. Most of these substances also work as antioxidants. The effects of flavonoids on the immune system are complex and poorly understood.

Flavonoids such as quercetin are found in many plant foods and are associated with a lower cancer risk. Derivatives of quercetin in lab tests have shown antiviral activity against such well-known viruses as polio and the common cold. However, when quercetin is tested in isolation it does not have the same anti-viral effect as when combined with vitamin C. Quercetin is easily oxidized and needs vitamin C to prevent the oxidation from occurring. Nature makes quercetin and vitamin C partners in plants. Can you see how extracting single nutrients from foods plays havoc with the way nature intended for them to work to keep us well?

How about the licorice root? Legally, the extract of licorice root is approved by the FDA only to be used as a sweetener or flavoring. It seems an unlikely place to find health benefits, and conclusive evidence is still pending, but some of the "best colon and breast cancer preventatives in lab animals are in licorice root extract." The phytochemical responsible is called glycyrrhizin. This chemical, which is fifty times sweeter than table sugar, is being studied by Japanese researchers for its possible link in bolstering the immune system, cancer prevention, and possibly to counteract HIV. It has anti-inflammatory action that soothes sore throats and ulcers. Licorice-flavored throat lozenges typically do contain true licorice extract, as does black licorice candy, but many candies labeled "licorice flavor" actually are flavored with anise oil. Much more research is needed to confirm the anticancer potential of licorice. Toxic reactions have occurred from eating too much, an amount which varies from person to person. Supplements are not advised; too much can raise blood pressure to dangerous levels, possibly triggering a heart attack, and there's no telling what else the supplements contain. They could be contaminated with microbes from the root, or riddled with iron filings from the grinding process. I do not wish to encourage perpetual munching on licorice candy or to single out licorice as being necessary for optimal health. I mention this study reported in

Environmental Nutrition, September 1994 to underscore the pervasive characteristics of phytochemicals throughout the plant kingdom.

ENTER THE SOYBEAN

It turns out that plants have hormones too—called phytoestrogens. They are weaker versions of the human estrogen. The soybean is a prominent source of several phytoestrogen compounds. The question has been asked, Why is there no Japanese equivalent for the term “hot flash”? Is it because Japanese women are reared not to complain, or does it have something to do with a lack of these menopausal symptoms? It, has been discovered that in countries where the diet is high in soy foods, such as Japan, China, and Korea, both breast cancer and prostate cancer are much lower than in the West, and symptoms of PMS and menopause are scant. Both breast and prostate cancer strike in response to sex hormones, and it is hypothesized that the plant estrogen in soybeans mediates both estrogen and testosterone in a way which curbs elevated levels of these hormones, which could factor into cancer potential. In women these phytoestrogens work to lift estrogen levels in response to menopause when the natural levels of estrogen have declined. Researchers speculate that phytoestrogens may one day prove to be an alternative to estrogen replacement therapy. So far about three hundred plants with phytoestrogens have been identified, including oats, barley, apples, carrots, and corn. They are present in a wide variety of fruit and vegetables, but they are most potent in the soybean. (Summary of a special report in Tufts University *Diet and Nutrition Letter,* February 1995, Vol. 12, No. 12.)

Soybeans also contain phytochemicals which appear to play a role in lowering cholesterol and countering heart disease. They contain multiple cancer-fighting compounds. Genistein, found only in soy, has the ability to block the development of cancer at several different stages. Over thirty laboratory studies have been done which support Genistein’s inhibitory effect on the growth of cancer cells. *(Environmental Nutrition,* May 1994, Vol. 17, No. *5.)*

As one reviews the research being done with the soybean there is hardly a dimension of the disease process in which it does not hold potential to play a preventative role. That is true for everything from diabetes, gall bladder and kidney stones, to high blood pressure, heart disease and cancer. The type of fiber and protein which soybeans contain, added to their rich array of plant chemicals, make the soybean a unique and potent contributor to a host of health benefits.

Problems in evaluating the impact of soybeans are that they come in numerous varieties, and that they are manipulated into a wide range of products. The chemical configuration of soy sauce, tempeh, miso, soy milk, or tofu is different than that of the whole soy bean. Once again, whole is best, but soybean products are still of benefit and provide variety in the diet. Soy sauce is the weakest link to the whole soybean. Soybeans can be used in salads, soups, burritos, to make burgers, or any other way you would use legumes. You may

also use soy milk or tofu as a base for making sauces, dressings, soups, mayonnaise, cream cheese, or whipping cream.

You will find that researchers are slow to say that any of these phytochemicals will "directly" prevent cancer or heart disease. There have not been enough human studies done to support those claims. The same is true for the anti-oxidants, beta-carotene, vitamin C, and vitamin E. It's difficult to determine the specific mechanisms and to identify the precise points of intervention in the disease process whereby these plant chemicals offer their protection. That is complicated by the generally slow, often insidious development of disease. Heart disease and cancer progress over a number of years. It's thought that it may be eight to ten years before a malignant breast tumor is actually detectable. Time is needed to obtain conclusive information. However, we need not wait for full explanations. From what we do presently understand, it is evident that plant substances, whether in the form of vitamins, minerals or other phytochemicals, function valiantly to fend off these diseases in numberless ways and at several different stages of development.

CONCLUSION

There have been over one hundred studies done which consistently link a high intake of fruit and vegetables with a decreased risk of heart disease and certain cancers, including lung, breast, colon, rectum, esophagus, larynx, oral, stomach, pancreas, prostate, bladder, ovary, endometrium, cervix, and thyroid cancer. "Raw fruits and vegetables appear more potent than cooked in protecting against cancer."***115**

The evidence is deafening; all the research being done is being done with plants! It is a wide array of substances from plants working in concert to provide health protection. Researchers have an arduous task attempting to ascertain the specific mechanisms which make that possible. Imagine the discoveries to be found in the tomato alone; it contains more than a thousand phytochemicals and presently we know of two which offer valuable anti-carcinogenic potential.

Researchers have suggested that a key to understanding the health benefits of the Mediterranean diet may be due in part to their intake of raw tomatoes. A study reported in the December 1994 issue of *Environmental Nutrition* indicated that of the three thousand adults studied, those who ate seven or more servings of raw tomatoes per week had a fifty to sixty percent lower risk of developing several types of cancer than people who ate two or fewer servings per week. What is true for the number of chemicals in the tomato is true for numerous plant varieties. We have only opened the window of discovery on this intriguing development. It may be said that we do not have enough hard evidence to jump to conclusions about how plants influence our health, but no matter what new chemical equations are discovered, it is safe to say that we do know the chemical interaction of their nutrients is the most potent form of disease prevention we possess.

Lest it sound like these vitamin, mineral, and phytochemical substances are some sort of magic wand to wave away all health problems, I must clarify that it would be gravely misleading to expect bounteous results just from adding supplements to otherwise poor health habits. The benefits from these substances come from eating a wide variety of whole plant foods in conjunction with health practices directed toward keeping the entire mind and body fit.

Since the recent discovery of phytochemicals, there have already been efforts to make these substances available in capsule form or utilize them as food additives. Many of these products will be marketed as nutraceuticals—a new classification under regulation of the Food and Drug Administration. They will likely become another multi-billion-dollar industry. As with so many other supplement formulations the public will have to evaluate the veracity of their claims.

I am not advocating total avoidance of all such products, but I hope I have been clear in pointing out that the benefits of the whole food cannot be duplicated. This should have become even more evident as we pondered the numerous phytochemicals packaged in each single plant product. Most of these substances have never seen the inside of a vitamin bottle because their identities were unknown. I have avoided recommended daily allowances, milligrams, and micrograms or other unit equivalencies as methods for determining how much of these substances should be eaten. I would rather keep it simple and think in general terms of increasing intake from the host of plant foods available. Concepts from the food pyramid included in the last chapter may be a helpful guide. We need to plan our eating around a wide variety of grains, legumes, fruits, and vegetables. It’s easier to remember if you’ve eaten five, six, or seven servings of fruit or vegetables in a day than to get bogged down in whether you’ve had so many milligrams of this or that. If one has a general idea which foods contain needed nutrients and eats liberally from among those foods, it will go a long way toward making dietary improvements.

I hope I have clearly communicated the vast network of cellular activity to which all of these nutrients contribute and that one simply cannot isolate one single nutrient as more beneficial than another. Since it is the case that we are forever learning more about how these plants offer us protection, and that it is likely that new substances will continue to be identified and research will intensify, it seems the wisest choice is to eat liberally from the kingdom of plants. Have you ever noticed that nobody ever holds up a chicken wing, leg of lamb, or oyster and points to it as the most recent discovery to prevent disease and keep us healthy? The pearl of health is found in plants. It really cannot be any other way. Plants are the supercharged power foods. Plants take in one form of power, light; and convert it to another power, chemical difference. Indeed, what a profound difference these chemicals make.

THE ORCHESTRATION OF CHEMICAL REACTIONS

Since we have been discussing the positive impact of the chemicals found in nature's pharmacy, now would be a good time to provide a brief sketch of the way chemical reactions are regulated. The regulation of all body processes is vital to maintain homeostasis, or a healthy balance among all of the interconnected body systems. That is so important to optimal body function that there are several layers of regulation within the body as well as a system of checks and balances. You have seen that vitamins, minerals, and phytochemicals play a role in thousands of chemical reactions which work to prevent disease. We have also mentioned enzymes and hormones, two types of vital body regulators.

In a most basic sense, disease stems from a system which has been put out of balance. I will underscore again that our bodies are very much like a chemical laboratory. In a lab, chemicals are mixed in test tubes and reactions take place one at a time. In the body, chemical reactions take place in our 75 to 100 trillion cells rather than test tubes, with several thousands of reactions occurring simultaneously. Regulation is actually a complex communication system among this vast network of cells. To control reactions in a test tube, the chemist can adjust experimental conditions, such as temperature, pH, concentrations, and solvents. In our bodies, temperature, pH, and solvent cannot be adjusted; they are constants. The solvent must be water, the pH must be nearly neutral, and the temperature must be maintained within a narrow range to keep us alive.

Yet our body must have some device by which reactions can be controlled and adjustments made. The body must have a way to regulate these thousands of reactions so that all body systems operate smoothly. These responsibilities fall primarily to enzymes, hormones, and neurotransmitters. Enzymes work to speed up reactions, thus they are referred to as catalysts. Starch and water react very slowly under ordinary circumstances, but when enzymes are added into the mix, the breakdown of starch is speeded up. You can well imagine the importance of enzymes in the process of metabolism, which converts our food to usable energy. Enzymes are designed to perform specific tasks; some catalyze only a single reaction, and some enzymes are able to catalyze up to 600,000 such reactions per second. The compounds that enzymes work on are called substrates. Enzymes are involved in the oxidation reactions, in bonding substrate compounds together, transferring molecules from one substrate to another; in short, they are involved in all molecular reactions.

Enzymes are composed primarily of proteins, but many contain small non-protein portions called cofactors. As it turns out, many of these cofactors are vitamins and minerals—to do its job the enzyme must have both its protein component and cofactor.

Perhaps this brings more clarity to why vitamins and minerals are so important and why they are involved in such a diverse array of body processes. It is estimated that there are at least 50,000 enzymes for regulating reactions

within our cells. Enzymes are something like a vast orchestra: each one has its rhythm to keep and particular notes to add to make the composition complete, but in order for the enzyme players to coordinate their individual activities in the cells and keep our bodies in chemical balance or harmony, they need a conductor to bring all of the parts together.

That is where hormones come in. The body's control mechanism for regulating and coordinating cellular activity is the endocrine system. The endocrine system is made up of different glands which secrete hormones. Enzymes work within cells, but hormones travel from their specific gland via the bloodstream to deliver their message to target cells throughout the body. When the hormone is bound to a receptor site on the cell's outer surface, it initiates a physiological response within the cell. Generally this entails turning a physiological mechanism on or off. The master conductor of the endocrine system is the hypothalamus located at the base of the brain. It secretes tiny amounts of hormones into the bloodstream, setting in motion a progression of hormone release from various endocrine glands to their target cells. Neuro-transmitters function in a similar manner. Hormones can carry their chemical messages from a gland to the target cells (or tissues) which may be some distance away in the body, but neurotransmitters mediate the flow of nerve impulses by transmitting a signal between neighboring nerve cells. I do not want to get bogged down in chemistry, but I do want to provide at least a skeleton outline of how the body functions in order for you to make sense of the way food influences our entire being.

There is another whole dimension of physiological chemical reactions which we have not even touched upon. I will only make passing mention of them to again underscore the concept that food creates chemistry, and that the food we choose to eat on a regular basis is far more potent in determining our well-being than any medication or pill yet devised. We have stressed the fact that hormones are the body's regulators and that the countless number of separate reactions which take place throughout the body do not occur randomly. A relatively recent discovery of a group of superhormones called eicosanoids will very likely catapult us into an ever expanding comprehension of just how critical food choices can be in this regulatory process, once we begin to understand just how these eicosanoids work.

We have only begun to scratch the surface on what is yet to be known about eicosanoids, but we do know that they play a ventral role in the control of hormonal regulation. You can be certain that we are going to hear much more about them. Perhaps one day they will become as commonly acknowledged as cholesterol. At the moment they are considered to be among the most potent biological agents known, but outside the world of research, we hear little about them. The array of superhormones which compose the eicosanoid family are referred to as prostaglandins, leukotrienes, hydroxylated fatty acids, lipoxins, and thromboxanes. They participate in the control of every vital physiologic

body system: the immune system, central nervous system, cardiovascular system, reproductive system, digestive system, and so on. Because of their ubiquitous and critical role in all of these systems, they possess a major potential to affect the disease process. In fact, there are those like Barry Sears, Ph.D., author of *Enter the Zone*, who indicate that optimal health can be biochemically defined as a balance of eicosanoids. Only since the 1970s has technology developed instrumentation with the ability to study these substances. It is now known that fatty acids are critical to the formation of eicosanoids, and that our choice of the right kind of fat to eat, in addition to making sure that we are maintaining a balanced nutritional intake, is essential to the formation of beneficial eicosanoids and the accompanying protection from disease which this very special chemical family provides. Not surprisingly, exercise also makes a positive contribution to a healthy eicosanoid balance.

What I've described here is but a meager depiction of the intricacies and complexities of physiological processes. As is the case with everything we study about the body, what remains to be learned is far greater than what we already know. What I am hoping to emphasize is how any disturbance in the body's regulatory procedures would throw this system off balance and would open the door to malfunction and disease. When we talk about how excess fat can influence hormone levels, you can understand how that would disrupt body regulation on a variety of levels. The same would be true if one were lacking the necessary vitamins and minerals to keep the enzymes humming. It also becomes apparent that mind and body cannot be separated as the chemistry which results from the food we eat feeds every one of our trillions of cells. We know that the level of certain neurotransmitters to the brain is influenced by the amount of carbohydrate or protein that we eat, and that these neurotransmitter levels make a difference in our level of alertness or relaxation, and that they play a contributing role in perception and emotions as well.

Our orchestra of over 50,000 enzymes was designed to work in a brilliant, rhythmic compatibility with its conductor hormones and neurotransmitters so that no discordant note would sound. We assist in writing the harmonies to this elaborate musical score by the importance we give to daily choices regarding the care and feeding of our bodies.

(Reference for this section: John McMurry, *Essentials of General, Organic, and Biological Chemistry*, Prentice-Hall, Inc., New Jersey, 1989, pp. 340—61.)

4

Nature's Lament

Thus far our examination of the benefits to be gained from a vegetarian diet has focused on the almost exhaustless, remarkable health protecting characteristics of plants and how, by capturing the sun's life-sustaining energy, they are ideally suited to provide the body's premium fuel source. We have touched on body chemistry and how plant foods efficiently and effectively work to promote an ideal balance of vital nutrients necessary for optimal functioning of all the body's interrelated systems. Numerous studies have underscored the harmonious, symbiotic relationship which exists between plant and man. This relationship impinges not only upon our personal health and wellbeing, but it extends to our environment, natural resources, and the "wellness" of this small blue planet which we call home. Now we will turn our attention toward the environmental implications of a flesh-based versus a plant-based diet.

The production of animals to be eaten is chewing up vast amounts of our priceless natural resources. It is destroying rain forests, depleting our soil, and polluting both our water and air. The toxic chemicals used to sustain the production of animals are concentrated in their dead bodies and remain to circulate throughout our environment in our water, land, and air, exposing us to hazards we do not yet fully understand. We are tampering not only with our ecosystem, but with our future. We can only speculate about the long-term effects of these toxins on our immune system and their potential impact on DNA. We cannot track how these toxic molecules, trapped inside our bodies, will influence the health of future generations. We do know that there is no substitute for water, and that depleted, eroded soil may take a devastating toll on the quantity and quality of our food supply. The three sections in this chapter draw most of their statistical data from *Diet for a New America* by John Robbins.

SOMETHING'S FOWL

(Reference: *Diet For A New America*, pp. 48—72, unless otherwise noted.)

I was fifteen years old when I became a vegetarian. It was not the implications of a high-fat diet and its relationship to heart disease, cancer, or other illnesses which served as an incentive. I did know that what I ate influenced my health and state of being, but research on diet and disease had little to do with my decision. It was a warm fall afternoon when I found myself waiting at a stop sign as a car passenger behind a truckload of chickens en route to the slaughter. I had never seen so many chickens together in one place. They were packed into wire cages which were stacked from the bed of the truck to the

sky. They seemed frantic, their heads darting in all directions from between the wires, clucking, flailing about, with feathers whirling in a white blur on all sides.

Those few moments became indelibly etched in memory. I can still close my eyes and see them. It was enough to convince me that this was senseless. I was not sitting, club in hand, in my Stone Age cave, wondering where my next meal would come from. It was not necessary to kill in order for me to live. Why was I eating like a barbarian? I acknowledge that there are some civilized places on the globe where people still do rely on the hunt as a means of survival, but in my world, food was plentiful and easily obtained. My life was totally sheltered from the world of animal production and slaughter. I thought only as far as how the food on my plate looked and tasted. Those nearly breathless chickens spoke to me philosophically in a way I could not deny. They forced me to examine my values, and in those few provocative moments a choice was made that would last a lifetime. People sometimes ask if it was hard to “give up” eating meat. For me, there was never even a split second of difficulty attached to it. I never felt as though I was giving something up. I felt as though I had opened the door to a new beginning. Perhaps that’s how it is when you are fifteen and idealistic.

Every now and then I hear or see documented horror stories about slaughterhouse techniques. I’m not certain how to evaluate the psychological implications of our own treatment of one another in light of what has become a generally inhumane treatment of animals and disregard for their lives. Does it in some way desensitize us to the sanctity of human life? It’s another question which impinges upon our individual philosophy of *life.*

We do know for certain that the production of animals has become a huge business. There may have been a time when the family cow or chicken was a safe means of obtaining dairy products and eggs. In today’s animal factories these creatures live under conditions which are artificially manipulated primarily to make a profit. They have little room to range, but instead are crowded into warehouses, stalls, or feedlots where they subsist on laboratory diets almost totally devoid of food as it comes from nature. Chickens are fed an unnatural concoction of sulfa drugs, hormones, arsenic compounds and antibiotics from their first day to their last. They are also fed large quantities of fish meal, which is a hazard in itself. We will address that issue in the following section. Chickens are also deprived of natural light. For them the lights are turned off—and this simply defies all that we know about the essentials for living and circadian rhythms. What does it do to the health of the chicken to be deprived of the life-promoting characteristics of the sun’s energy? The action of sunlight influences an array of body functions from vision to the neurotransmitters which influence our appetite and moods. Humans deprived of sleep and light for long periods of time may suffer a range of symptoms from mild depression to insanity. It would seem that chickens are an easily understood example of the way biological rhythms can dictate existence. All of us are familiar with the predictability of the rooster’s crow to welcome dawn.

In order to increase egg production and to make the chickens grow at the fastest rate for the least cost, the chickens live in windowless warehouses of 80,000 birds or more, where they are deprived of the sun's natural light and warmth. Artificial lighting is manipulated contrary to the natural 24-hour cycle of day and night. "Broilers are often subjected to bright light 24 hours a day for the first two weeks. Then the lights may be dimmed slightly and go off and on every two hours. At about six weeks of age, the animals have gone so completely crazy from all this that the lights must be turned off completely in an attempt to calm them down" *(p.58).*

This is not the only contributor to their frantic dispositions. Cramming 80,000 chickens into a warehouse defies the natural social order of their species. We have all heard the expression "pecking order." Chickens unable to establish social order peck at each other constantly and are often eventually driven insane. Instead of attempting to disrupt this behavior by creating a more natural environment, breeders simply cut off their beaks. This is a painful procedure which makes it difficult for the bird to drink. Eighty thousand birds in one warehouse translates into five birds crammed into a cage which measures sixteen inches by eighteen inches. This conserves on heating bills and keeps the chickens from piling on top of one another in response to their nearly perpetual state of panic. Removed completely from any solid ground whereby their toenails might be naturally groomed, they instead continue to grow until they become very long and may get permanently entangled in the wire of their cage. In time the flesh of the toes grows around the wires. This places the chicken in a position where it is unable to reach either food or water. Thus it faces death by starvation. The solution; cut off the toes of chicks when they are a day or two of age.

I guess this practice just follows the typical chicken factory mentality. There are actually animal institutes trying to breed chickens without legs and feathers to accommodate their assembly line lifestyle. It takes time and money to remove feathers. As it happens, they may not have to worry about breeding to remove feathers; chickens seem to be developing unexplained health problems in which they are losing feathers on their own. It's not understood whether this is due to rubbing against the wire cages, feather pecking from other birds, their totally unnatural diet, or lack of sunlight. The featherless skin becomes raw, red and sore from rubbing directly against the wire. Perhaps that might afford pause for reconsideration regarding the wisdom of breeding a featherless chicken. Can you imagine the amount of stress hormones which would be in continual circulation throughout the chicken's bloodstream in response to these conditions? Not to mention the potent influx of stress hormones which would be released at the time of slaughter. Because we give little thought to the quality of the chicken's blood, we know almost nothing about how these stress chemicals may influence our health when the blood of the animal becomes a part of our own blood system.

"It's hard to underestimate the health of today's chickens. Driven to a state of hysteria, their raw skins rubbing constantly against the wire cages in which they are packed like living sardines, a staggering percentage of these animals contract cancer. A government report found that over ninety percent of the chickens from most of the flocks in the country are infected with chicken cancer (leukosis)" (p. 67). In fact, "due to the danger of contracting diseases from chickens, the Bureau of Labor has listed the poultry processing industry as one of the most hazardous of all occupations" (p. 66).

Chickens are not bred for health; they are bred for money. The paragraphs above are not an atypical account. These conditions represent standard operating procedures for the factories producing ninety-eight percent of this country's eggs and poultry. Chicken breeders respond by saying they must maintain these methods for the public's sake—that is the only way to maintain reasonable chicken prices. I don't doubt that is true. Sadly, inhumane and anti-health animal feeding and breeding practices are not exclusive to chicken factories.

Turkeys, geese, cows, and pigs all have a tragic story of their own. The question is, How could anyone esteem chicken as a health food? Chicken is lower in fat than red meat, not much different in terms of cholesterol and certainly not worthy of a routine place on a health conscious plate. If this kind of automated, artificial, diseased method of chicken and egg production doesn't do something to diminish your taste for the bird, for your health's sake consider raising your own.

A FISH TALE

(Reference: *Diet For A New America*, pp. 308—349.)

Human contamination with PCBs comes mainly from eating fish from waters in which PCB levels are high. It may seem that the simple solution is to find fish from uncontaminated water. Good luck. Nearly a million tons of PCBs have been produced with persistent biological longevity. "They have been found in wild polar bears and fish from the deepest and most remote parts of the world's oceans. It is now likely that there is not a single human being anywhere on this planet who does not carry PCBs in his or her flesh" (p. 330). They exist in every river in America and in snows of the Arctic and Antarctic. Lakes, rivers, and inland waterways are generally the most polluted, but oceans have not been spared.

Fish have an enormous capacity to absorb and concentrate toxic chemicals from their environments. There are two major factors which make this possible. First, fish eat from long food chains. Tiny fish eat the phytoplankton, small fish eat the tiny fish, medium fish eat the small fish and large fish eat those beneath themselves, and on and on. At each step in the chain, toxins are concentrated exponentially. The Environmental Protection Agency estimates that fish can accumulate up to nine million times the levels of PCBs in the waters they traverse. The second contributing factor is that fish must breathe the polluted

water they live in just as we must breathe our own polluted air. Shellfish that filter water, such as oysters, clams, mussels, scallops, and other mollusks, are exceedingly susceptible to pesticide saturation. An oyster will filter up to ten gallons of water per hour. In a month's time an oyster can accumulate toxic chemicals at concentrations 70,000 times the amount in the water (p. 331). So what does another chemical matter in the scheme of things? It should be evident by now that all chemicals contribute to body chemistry and that minuscule, submicroscopic amounts can have a potent effect. That is what we are finding out about PCBs.

Primates have developed fatal cancers and given birth to deformed offspring as a result of PCB exposure as low as one part per million. Are any fish safe to eat? Logically it would seem the safest options are smaller deep ocean fish. You decide what risk you are willing to take. A study reported in the Tufts University *Diet and Nutrition Letter* had this to say: As a result of comparing the offspring of 242 women who ate varying amounts of fish from Lake Michigan, it was found that the more fish the mothers had eaten, the more their babies showed slower response to stimuli, abnormal reflexes, general weaknesses, and signs of depression.

Even eating fish only two or three times a month produced babies with smaller heads and who weighed seven to nine ounces less at birth.

In 1986, a follow-up study indicated that there was a definite correlation between the amount of fish the mothers had eaten and the child's subsequent brain development—even if the mothers ate fish only once a month. It was also discovered that the more fish the mother had eaten, the more poorly the children did on a test to measure future verbal I.Q. (pp. 334—35). It sounds almost unbelievable.

A recent government report found PCBs present in one hundred percent of the human sperm samples tested. The sperm count in American males is only seventy percent of what it was thirty years ago. PCBs are considered to be a major contributor to this development. Research at major universities indicates that nearly twenty-five percent of today's college students are sterile. Just what are the contributing factors to the rising infertility problems which seem to be growing from one passing decade to the next? Nobody has easy answers.

But consider the methods we have set in motion in an attempt to remedy this situation. Sperm banks, surrogate parents, in-vitro fertilization—these would have seemed like science fiction to our great grandparents, and we are still working our way through the morass of consequences, both legal and moral. I'm not placing an evaluation on these methods. I just wish to underscore the extensive implications of something as seemingly innocuous as a contaminant introduced into our environment at one part per million.

Chicken and fish seem to have received a special dispensation because they are not red meat. Even though they may not contain the same amount of saturated fat as other meat choices, they still do contain cholesterol. This does

not make them especially blessed. It is not uncommon to hear someone say, I am a vegetarian but I eat chicken and fish. Since when are they classified as non-flesh? Many nutritionists still advocate the inclusion of fish as part of a healthful diet. Their rationale is that fish contain the beneficial omega-3 fatty acid which is considered to be protective against heart disease. As already mentioned, omega-3s can also be found in plant sources. Even staunch advocates for fish recommend contacting the local health department to find out what fish in your area may be too contaminated to eat. They also admit that fish inspection is poorly regulated, and that more needs to be done to determine fish safety. These stipulations indicate potential dangers, many unknowns and risks. How does one track just where a fish has been and what it has been eating?

Contamination is a very real threat to health. And the revolving door continues its damaging effect. Livestock in today's factory farms subsist on huge portions of fishmeal. Livestock eat half of all the fish caught in the world. More fish are consumed by U.S. livestock than by the population of all the countries of Western Europe (p. 331). Since all the tactics of animal factories are bent toward the bottom line, it is not likely that they will regularly check for toxic chemicals in fish meal or in any other of their animal feed concoctions. When they do check, it's like opening Pandora's box.

In 1979, when chickens were tested for PCBs at one of the world's largest chicken factories located in Idaho, PCB concentrations were so high that one poultry sample couldn't even be measured. Almost three million dollars worth of egg and poultry products had to be destroyed (p. 332). "In 1978, Ralston Purina had to recall 2,500,000 pounds of animal feed they had sold that was made from fish meal which they discovered to be heavily contaminated with PCBs" (p. 332). And once again it meant millions of eggs and nearly a half million chickens had to be destroyed because they had eaten the feed.

These are not isolated incidents, but only two among many examples which could be cited. Only a fraction of such cases are actually reported, and quite understandably, few are brought to the attention of the public. Poultry executives claim they don't want to alarm the public, but inherent in their concern is also that precarious bottom line. People do have to protect their interests, but at the same time these conditions are alarming. They hold potential for a red stage alert.

Unfortunately PCBs are only one of a litany of toxic chemicals to which we are exposed in our food and in our environment. In 1986 a variety of heptachlor known as chlordane contaminated 200,000 chickens in Arkansas. All had to be destroyed. In the same year milk contaminated with heptachlor had to be recalled in Arkansas and five surrounding states. At the same time beef supplied by a USDA Donated Program to California elementary and high schools had to be recalled for heptachlor contamination. Arkansas authorities found heptachlor contamination in the breast milk of seventy percent of nursing mothers. A study

in Hawaii of 120 infants whose breast milk was contaminated with heptachlor found development of the infants' brains to be significantly retarded (p. 324).

In the 1970s, PBBs accidentally were mixed into livestock feed in Michigan. It is suspected that every person who consumed meat, dairy products, or eggs in the state of Michigan during 1976—77 has the carcinogen in his or her organs; ninety-six percent of nursing mothers in Michigan had PBBs in their milk. PBBs can be stored in body fat indefinitely, where they then become capable of being passed on to future generations. During pregnancy they can cross the placenta of the developing fetus, and hold the potential of producing physical defects in utero (pp.*324—5)*.

Remember DDT? It was banned over twenty years ago, but only after 2.2 million tons of it were spread across the planet. It still continues to be found everywhere from the bodies of penguins and seals in Antarctica to frogs living in very high altitudes of remote regions of the Sierra Nevada.

Dioxin is many times more toxic than DDT. Millions of pounds of this dangerous chemical have been sprayed on land in the U.S. It is considered to be one of the most lethal chemicals known to man. One drop would kill a thousand people. Even at the lowest possible dose, a few parts per trillion, it kills many research animals even before they have a chance to develop tumors. It causes cancer, birth defects, miscarriages, and death in lab animals. It is present in all beef and dairy products of the cattle which graze on this dioxin-blighted land (p. 321). There is evidence that dioxin and other toxic chemicals damage the thymus gland, which plays a critical role in the body's immune system.

A study reported in the *Journal of the American Medical Association* would seem to lend additional support to this evidence. Extensive research was carried out by the joint efforts of the Centers for Disease Control in Atlanta, the Missouri State Health Department and St. Louis Medical School regarding the effect of hexachlorophene on the immune system. Hexachlorophene contains traces of dioxin and was at one time considered among the safest of germ killing compounds. Hexachlorophene was mixed in a sludge used to keep the dust down in a Missouri mobile home park. Researchers meticulously made a comparison study over a period of years between the people who lived in the mobile home park exposed to the chemical sludge and a control population with almost identical characteristics—such as race, employment, illness records, and exposure to substances such as pesticides, alcohol, and tobacco—to those who lived in a mobile home park where the sludge used to treat their roads was not composed of the dioxin-containing hexachlorophene. The results indicate why many scientists today are associating these toxic chemicals with the current plethora of immune system diseases. 'These researchers found significant damage to the immune system of the exposed people" (p. 327).

Foods of animal origin are the major source of pesticide residue in the diet. Of all toxic residue in the American diet, ninety-five to ninety-nine percent comes from meat, fish, dairy products, and eggs. It is not only because they are

fed massive amounts of fish meal or other feeds which have been grown on heavily sprayed, contaminated land, but they are also dipped, sprayed with, and intentionally fed poisonous compounds never intended for animals raised in a more natural way (p. *315).* Yearly, over a million cattle are dipped or sprayed with several million gallons of deadly solutions to kill parasites. These carcinogenic poisons are absorbed through the animal's skin and stored in its body fat.

Flies are another pestilence to contend with and are handled in the same manner; sprays are used to kill flies around the livestock, or larvicides are mixed into animal feed where upon wending their way through the animals' digestive tracts they finally end up in animal manure which then becomes chemically toxic to flies that would breed there. That is not to say that plants don't also get sprayed with these toxic chemicals. "But meat contains at least fourteen times more pesticides than do plant foods; and dairy products five-and-one-half times more" (p. 343). Another dismal result of widespread use of pesticides and herbicides is that they are causing numerous resistant insects and weeds to evolve, which in turn require increased dosage and potency to control. Who knows where this will end?

Even though in theory the hormones fed to animals are supposed not to enter our blood system, but instead to be excreted, I admit to being leery. Remember DES? This hormone was hailed as a miracle by livestock producers because it developed more fat and weight on their animals, and subsequently more profit for the industry. Tons of this hormone were administered to animals whose flesh and milk became food for an unsuspecting public. Then came the discovery that DES caused cancer in even the most infinitesimal amounts, and sex changes such as breast enlargement in children, and impotence or infertility in adults became directly linked to accidental absorption of this miracle hormone. After a bitter battle, DES was made illegal to feed to livestock. However, several years after the ban no less than a half-million cattle were found to have been illegally implanted with DES. It is still being used illegally today, and where it isn't, a number of sex hormones with similar effects have been marketed in its stead (pp.3 12—13).

The amount of pesticides and other toxic chemicals that are being used has mushroomed over the past twenty years. The chemical companies which promote these products claim they are as safe as aspirin, and that the poisons are in such invisibly minuscule quantities that we needn't worry. That might be valid if we were dealing with only one poison in a single, controlled usage. But we have concentrated these contaminants exponentially by cycling and recycling their impact on every level of the food chain and have combined and overlapped their usages in ways we don't even begin to understand, much less are we able to control.

All of these poisons are stored in the body fat of birds and animals with nowhere to go but into our mouths, where they are again recycled through future

generations. It strikes me that cholesterol and saturated fatty acids represent only a sampling of the army of hazards which come packaged in animal fat.

We know that excess animal fat intake influences male and female hormone function in our bodies, but what about the implications of ingesting animal sex hormones and their potential impact on our body chemistry? Added to that are the numerous viruses and other diseases which animals carry. We cross our fingers and hope they aren't transmitted to humans. And as if that weren't already more than should be swallowed, we have toxins in the form of pesticides to add to the list.

It seems that animalizing our plant foods as second-hand nourishment almost points a finger at our better judgment. We face the unanswered question of why so many diseases related to depressed immune function are on the rise. Cancer and AIDS alone keep us scrambling to discover what can be done to intercept or halt the progression of these terminal diseases. Most certainly these diseases have multiple causation factors, but it may be we have not taken the ubiquitous pesticide presence seriously enough. "Forty years ago, cancer in children was a medical rarity. Today more children die from cancer than from any other cause" (p. 329).

And consider the rash of learning disabilities and emotional problems. One author writing in the late 1800s made an observation which seems to strengthen with the passing of time: "The violation of physical law, and the consequence, human suffering, have so long prevailed that men and women look upon the present state of sickness, suffering, debility, and premature death as the appointed lot of humanity."***116**

What are we doing to ourselves? The most poignant detail in all of this muddle is that we will never know what might have been if we hadn't submersed ourselves in this toxic sea. From small shades of difference to malignancies which alter life immeasurably, we ask ourselves: Would Julie have been able to get better grades in school; would George have been easier to get along with; would our favorite aunt or uncle, mother, father, son or daughter have lived longer or less painfully if...

It may be we will finally be forced to reckon with that age-old axiom 'We reap what we sow'.

AN ENVIRONMENTAL DIRGE

(Source: *Diet For A New America*, pp. 350—381; unless otherwise noted.)

Many theories have been espoused regarding what caused the decline of various great world civilizations from the Mayans to the Egyptians and Greeks. One common point of view is that soil erosion destroyed the fertility base upon which these populations thrived. Two hundred years ago most of America's croplands had at least twenty-one inches of topsoil. Today it is down to six. The productivity of our nation's cropland is down seventy percent, with much of it

bordering on becoming wasteland. This is regarded by the USDA as an unparalleled disaster (pp. 356—7).

Each year the world’s farmers try to feed some ninety million more people with twenty-four billion fewer tons of topsoil.***117** A major contributing factor to this erosion is the artificial conditions we create by the demand to feed huge numbers of livestock. ‘The U.S. Soil Conservation Service reports that four million acres of cropland are being lost to soil erosion each year. Our annual topsoil loss amounts to 70,000,000,000 tons. Of this staggering topsoil loss, eighty-five percent is directly associated with livestock raising” (p. 358*)*. Where would you say we are headed?

As seems to be the case with almost everything, we set in motion a chain of circumstances where one thing continues to lead to another. In terms of our environment, what we see unfolding is the epitome of a pernicious Catch-22. When erosion ruins the soil in one area, new productive soil is sought. Where do we go? To our forests. Approximately 260 million acres of forest land have been converted to support our flesh-based eating habits.

Forests happen to be one of the few places where topsoil erosion isn’t occurring. But we are destroying our forests. For each acre of American forest cleared to make room for parking lots, shopping centers, houses, and roads, seven acres are converted into land for grazing livestock and/or growing feed (pp. 360—1). Deforestation is another by-product of meat production. At our present rate of deforestation, the U.S. will be stripped of its green robe of trees in just fifty years.

Can you imagine the repercussions of that? We are already experiencing skyrocketing costs for wood, but more important, trees are a vital source of oxygen; they recycle and purify our water. They moderate our climate. They transpire water to the air, contributing to rainfall. They are a home for millions of plants and animals, and are a tranquil respite for mankind. “Of the 260 million acres of American forest that have been converted to support our high-fat, low-fiber menu, over 200 million acres could be returned to forest if Americans were to stop raising food to feed livestock, and instead raised it directly for people” (p. 363).

Unfortunately, it is not only our own forests we have pillaged. The vast Canadian forests are feeling the pinch, as are the rainforests of Central and South America. It is projected that if something isn’t changed, the Canadian softwood reservoir will be depleted in forty years. Within twenty-five years the virgin rainforests of Central America have been reduced from 130,000 square miles to 80,000. At this rate, in forty years there will no longer be a rainforest in Central America—and that for the sake of imported beef used to make cheap hamburgers. We now import ten percent of our beef consumption, which may not sound like much, but ninety percent of it comes from Central and Latin America, translating into over 100,000 tons of imported meat (pp. 362—4).

We are tampering with our oxygen supply, our climate, and an ecosystem which supports half of all the species on earth. We are close to decimating nature's natural cycle of pest control by disrupting migratory patterns of birds and the important role they play in managing insects, and in turn how these insects eat other pests; and at a time when our need for natural alternatives to pesticides is crucial. Rainforests contain not only many of nature's pesticides, but many plant sources of medicinal value. We are only familiar with about one percent of the plant species in these priceless forests, yet one-quarter of our medicines are derived from raw materials found there. One such plant, the rosy periwinkle, has escalated the chance of survival for a child suffering with leukemia from twenty percent to eighty percent (pp. 364—5). Estimates of how many plant and animal species will become extinct yearly range from one thousand to ten thousand. These species will never ever be seen again.

And what becomes of this precious land razed of trees to grow cattle? Immediately after cutting, its nutrient value requires 2.5 acres to support one steer; within a few years it requires 12 acres due to land erosion, and in ten years it may require 20 acres because the land has become so barren. Not only does the land grow poorer, but the people grow ever more impoverished as well. When valuable farm land is used to grow food for cattle, the price and availability of local food is placed beyond the reach of the people (pp. 364—5).

Naturally our water is caught up in this Catch-22 as well. Over half of the total amount of water consumed in the U.S. goes for irrigation of land for livestock feed and fodder. Enormous quantities must also be used to wash away excrement. To produce one pound of meat takes an average of 2500 gallons of water (p. 367). Consider these comparisons:

To produce a day's food for one meat eater takes over 4000 gallons of water, for a lacto-ovo vegetarian 1200 gallons are required, and for a vegan only 300 gallons.

It takes less water to produce a year's worth of food for a vegan than to produce a month's food supply for a meat eater. What applies to water consumption also holds true for acreage needed to support these different eating habits. It takes twenty times more acreage to support a flesh eater's diet than to support the vegan. It takes up to one hundred times more water to produce one pound of meat than one pound of wheat. Rice takes more water than any other grain, but only one-tenth what is required per pound of meat. Rice is also a complete protein. *Newsweek* described it like this: "The water that goes into a 1000 pound steer would float a destroyer" (p. 367).

The processing of meat is subsidized at every step of production. Meat prices would be astronomical if citizens had to pay at the market for all these hidden costs. "If the cost of water needed to produce a pound of meat were not subsidized, hamburger, one of the cheapest meats, would cost more than $35.00 a pound" (p. 367). In the seventeen western states where precipitation is limited, the cries of drought would be measurably alleviated if these subsidized animal

factories were limited. Most of the water from these states goes directly or indirectly to produce livestock. Without this drain, water supplies could support an economy and population twice the present size (p. 368).

In states like Washington, Oregon, and Idaho the cost may not be as obvious in terms of water because of plentiful amounts of rainfall. However, a price is being paid in terms of electrical costs. These states derive eighty percent of their electricity from hydropower plants along the Snake and Columbia Rivers. "Economists calculate that the three-state area loses seventeen billion kilowatt hours of electricity a year to the gluttonous water use of livestock production. That's enough to light every house in the entire nation for a month and a half" (p. 369).

The effect of the meat industry on water supplies is felt in every part of the country. In the last twenty years alone, Texas has used up one-fourth of its entire supply of ground water primarily to grow sorghum for cattle (p. 371).

And if a steadily diminishing water supply isn't travesty enough, animal factories add pollutants to the water we have left. Five decades ago most of the livestock manure could be recycled to enrich the soil. Today numbers have grown to such an extent that this is no longer feasible. The wastes from these animals end up in our water. Few give much thought to animal manure; "but every 24 hours, the animals destined for America's plates produce twenty billion pounds of waste: that's 250,000 pounds per second" (p. 372). An egg factory of 60,000 hens produces about 165,000 pounds of excrement weekly. A small pork operation of two thousand pigs produces four tons of manure and five tons of urine daily.

A single cow produces as much waste as sixteen humans. This means that in a holding pen where you have 20,000 animals, you have a sewage problem equivalent to a city of 320,000 people. People can be taxed as a means to finance the construction of a sewage system designed to handle this load; cows cannot (p. 372). Much of this sewage becomes runoff into rivers, lakes and streams. This waste is high in nitrates (which can be carcinogenic), ammonia, phosphates, and bacteria. Both rural wells and city water supplies are increasing in nitrate levels. "The meat industry accounts for more than three times the harmful organic waste water pollution as the rest of the nation's industries combined" (p. 373). These wastes add to the growing number of pollutants which already swarm within our inland waters and oceans. Not only do they affect aquatic life, but they take their toll on something as simple and elemental as algae which affect oxygen supply and help to moderate the planet's temperature. The single biggest contribution we could make toward cleaner water is not to buy a bottle of Perrier, but to make a change in our eating habits.

We can't leave this sinkhole for our natural resources without a nod to the energy consumed in meat production. Energy is required, no matter what we grow. Not only do we pay for cultivation, but for processing, packaging, and transportation.

In 1985 consumers paid more for the packages on their food than the farmers received for the food itself.***118** Buying locally grown foods and shopping at farmer's markets are ways to reduce the energy costs of packaging and transportation. However, when it comes to energy waste, animal factories take the prize. "The production of meats, dairy products, and eggs accounts for one-third of the total amount of all raw materials used for all purposes in the United States" (p. 374).

In contrast, growing fruits, vegetables, and grains uses less than five percent. When energy costs for the production of flesh meats were compared with the energy costs for soybeans, corn, and other plants, it was found that even the least efficient plant food was nearly ten times as efficient as the most efficient animal food (p. 376). In fact, "Even the best of the animal enterprises examined returns only 34.5 percent of the investment of fossil energy to us in food energy, whereas the poorest of five crop enterprises examined returns 328 percent" (p. 376).

Corn or wheat provide twenty-two times more protein per calorie of fossil fuel expended than does feedlot beef; and the mighty soybean, also a source of complete protein, weighs in at delivering forty times more efficiency (p. 376). If one were to begin translating the potential savings related to meat production which would result from reduced spending on imported oil, transportation, utilities, subsidies, food expenses, medical bills, and the expenses incurred as we attempt to combat the assaults on our environment, we would not only add substantially to our personal savings account, but could take a chunk out of our government deficit as well.

There may be those who find these statistics unconvincing or exaggerated. So be it. That is not really what leaves the most lasting impression as I look at the big picture. What keeps on resounding is that all lines converge in the same place. It doesn't matter whether you are evaluating nutritional content, health benefits, production costs, conservation of natural resources, environmental issues, or pollutants, plant foods consistently come out on top.

Alas, there is one more melancholy verse to nature's plea. Perhaps it is the most plaintive of all. This exorbitant waste adds to the weight of human suffering. The world's cattle alone, not including chickens and pigs, consume a quantity of food equal to the caloric needs of 8.7 billion people—nearly double the entire population.

"Enough grain is squandered every day in raising American livestock for meat to provide every human being on earth with two loaves of bread" (p. 352). More cropland in the U.S. is used to produce feed grain for livestock than is used to feed people. Livestock consumes ten times as much grain per day as we do. We could use much of that grain to make grain products and share them. The shift could free up enough grain to feed 400 million people and would burn less fuel and use less water.***119** When we deplete the natural resources, such as

rainforests and agricultural land in other countries, we contribute to the severe poverty which exists in many parts of the developing world.

"One-fifth of the world's five billion people have no land and no possessions at all. They survive on less than $1.00 a day each; the average U.S. housecat eats twice as much protein every day as one of these people, and the annual cost of keeping that cat is greater than these people's annual income."***120**

It's not easy to be optimistic about the future when the consequences of our actions may be almost cataclysmic in scope. I am hesitant to accept that science or some amazing technological advancement is going to be able to undo the damage that has already been done. As I have already suggested, we know only a thimbleful of what there is yet to be known about chemical interaction within the body system. Since a number of years generally must pass before we become aware of the consequences of pollutants and toxins, there is no way in which science can keep pace with our current unhealthful trend. It would seem the better part of wisdom to err on the side of caution in determining what we will put inside our bodies. It may be that our greatest danger lies in accepting the notion that food choices are merely a matter of what suits our taste and giving no more thought to it than that.

Our food choices are not confined to our local market or individual household. They span the globe. It should be evident by now that food is bound to every facet of our lives. It is an expression of the way we see the world and the way we perceive our role and responsibilities in it. When I look at the pervasive repercussions of what have become our traditional eating habits, I am led to consider whether man was ever intended to subsist on a flesh-based diet.

To live healthfully means far more than a personal sense of well being and freedom from disease; it also encompasses putting our efforts into maintaining a healthy environment and in developing a health-enhancing spirit toward those with whom we share this planet. In a sense, health choices test and stretch our own characters. Hopefully we are learning as we go that there is a price tag on our behaviors as real as the dollars we pay for a pound of flesh. While we may escape paying full price over the counter, and may experience only vague or indiscernible immediate consequences to our behaviors, ultimately we may incur a debt which is terminal and impossible to repay.

5

Nature's Rejuvenators

Food is not the whole story on health. Just as a balance of nutrients is needed for optimal body function, a balance among diet, fitness, and other lifestyle factors is essential for optimal overall health and well-being. The emphasis of this book has been on food, but it is not enough just to eat nourishing, wholesome food and be done with it. This section will take a quick glance at what we can do for ourselves to augment sound eating habits with other life-promoting practices.

EXERCISE—"JUST DO IT"

In addition to the pharmacopeia supplied within plant foods, exercise also works to protect us from disease. Exercise plays a preventive role in heart disease, high blood pressure, adult-onset diabetes, obesity, osteoporosis, resistance to colds, infections, and depression. It improves circulation, lung function, skin and muscle tone, wound healing, lowers LDL (bad cholesterol) and raises HDL (good cholesterol).

Consistent exercise contributes to energy, vigor, and a positive attitude. It develops endurance, flexibility, and strength, grants us free range of motion with supple, pliable limbs and the support to carry out our daily routine and other chores without undue taxation or fear of injury.

If exercise could be marketed in a pill, it would be enthusiastically received as a magic potion for which supply could never keep pace with demand. It is sometimes referred to as a positive addiction because of its numerous physical benefits and its capacity for enhancing one's state of well-being.

If one is dieting, exercise is a must. Most dieters regain all or most of what they have lost in only five years' time. Severe calorie restriction or one-meal-a-day diets actually make the body conserve fat rather than lose it. The body prepares itself for an emergency state of food deprivation and acts accordingly, saving all the calories it can. A lifestyle which includes regular exercise and is fitness-oriented makes weight management much more likely to succeed and endure. Living life without exercise is almost like limping along on only one leg or settling for being less than fully alive; but then how could one know that, unless by comparison he or she were to give exercise a try? In light of its numerous advantages, it's safe to say the body was intended to be active. Couch potatoes, please beware of premature wrinkles and turning moldy or mushy due to just sitting around.

Exercise brings into play the sun-powered energy of carbohydrates. Carbohydrate in the form of glycogen is stored in our muscles. In the first ten minutes or so of moderate exercise the muscle relies almost entirely on its store

of glycogen. Within twenty minutes, one-fifth of available glycogen has been used, which leads to an increase of glucose uptake from the body's blood supply—*a thirty-fold increase.* One can see how this would affect conditions like diabetes.

As one continues exercising, the body begins to use less glucose and more fat. That's why it is recommended that a person exercise at least twenty minutes if he or she wants to burn fat (Many suggest a minimum of thirty minutes). Hormones regulate this mixture of fuels.***121**

Intensity and duration of exercise influence fat burning. It comes as good news to most that one need not be a marathon runner or exercise strenuously to burn fat efficiently. In fact, low to moderate intensity exercise, such as brisk walking, actually uses up more fat in proportion to the effort of the exerciser. And the longer the duration, the greater the percentage of energy contributed by fat.***122** Trained muscles develop more fat-burning equipment and so burn fat more efficiently than untrained muscles. And the more muscle one has in proportion to body fat, the more efficiently food calories are utilized. That makes weight management much easier. When one is physically fit, the need to juggle calories and weigh every morsel of food with guilt is greatly reduced.

It is the time during rest, after the exercise, that muscles are actually built up. The kind of exercise determines the shape and form the muscles will take. That means that cyclists often have well-developed legs; a tennis player may have one arm that is superior in strength to the other. It is good to vary our exercise routines to include balanced development of different muscle groups.

As might be expected, the kind of food we eat plays a role in exercise efficiency. A high complex-carbohydrate diet is ideal, since as we have already discussed, it is the premium energy fuel. Exercise greatly increases oxygen uptake, thereby bringing the antioxidant vitamins (A, C, and E) into play.

Vitamins and minerals play a key role in, energy release and exercise performance. The B vitamins are vital to energy release; and folate in particular supports the building of red blood cells which carry oxygen to working muscles. Vitamin C builds collagen necessary for the linings of joints and connective tissue. The mineral magnesium is especially crucial for building muscle. The trace minerals, chromium, zinc, and copper, have specific roles in physical activity and are currently being studied for a more comprehensive understanding of their effects.***123**

Athletic trainers for the NFL are advising their players to get the bulk of their calories from high carbohydrate foods in preparation for top level competition. An article in the November 1993 Tufts University Diet and Nutrition Letter stated that the days are past when players thought it was pounds of meat that would most efficiently fuel their engines. The Dallas Cowboys, recent Super Bowl winners, have been voted the healthiest team in the NFL by the Professional Football Athletic Trainers Society because it is common practice for team members to eat six servings of fruit and vegetables daily along

with plenty of low-fat grain-based foods. The players are particularly partial to broccoli, cauliflower, oranges, and bananas. As already mentioned, these foods are excellent sources of antioxidants, other phytochemicals and minerals.

The president of the Professional Football Athletic Trainers Society, who is also head trainer for the New Orleans Saints, described pregame meals for the Saints as consisting largely of fruits, cereals, pancakes, and pasta rather than fatty cuts of flesh foods. These food choices carry over into their other meals as well. More than seventy percent of NFL athletic trainers are now advising that players get the bulk of their calories from high carbohydrate foods.

A large number of athletes and exercise enthusiasts believe that supplementation is mandatory for optimal performance. They are an easy prey for claims made by purveyors of these products.

It is true that more of certain vitamins and minerals are excreted in the urine of people who routinely exercise. But in all the studies that have been done to determine whether an intake above the recommended daily allowances is required in compensation, none thus far have shown it to be true.***124**

A balanced diet rich in the plant foods which supply a bounty of vitamins and minerals offers ample amounts of necessary nutrients. The same is true for protein. Many athletes assume that an amount of protein greater than the normal dietary intake is required to build muscle. As we have already discussed, most people get more protein than they need. Exercise training not only contributes to more efficient protein utilization in the body, but a high carbohydrate diet also has a protein-sparing effect.***125** Extra dietary protein is not needed.

In order to improve health, it is advised that a person spend an accumulated minimum of thirty minutes in some sort of physical activity almost every day.***126** This is a shift from the recommendation that activity had to be sustained over a specific period of time. It has been proved, for example, that twenty minutes of gardening, plus ten minutes spent walking the dog at sometime during the day does have health benefits. However, for cardiovascular improvement and for greater health benefits, sustained activity for at least twenty minutes, a minimum of three to four times per week, is still recommended. Remember that this is the minimum.

The best form of exercise is that which you enjoy and will do consistently. Many experts now suggest a combination of aerobic activity and muscle-building as the ideal approach to overall fitness for men and women of all ages. Aerobics primarily burn fat, while weight training tones and builds muscles. Together they have a synergistic effect to make you look and feel better. In the October 1994 issue of the University of California at Berkeley Wellness Letter, it was reported that weight training does much more than just build muscles. Several studies show it can lower LDL (bad) cholesterol and raise HDL (good) cholesterol. The more elevated one's cholesterol is to begin with, the more marked are these improvements. The kind of weight training you do, its intensity and duration, will play a role in blood cholesterol levels. To lower cholesterol, it

seems that it is more important to do several repetitions using light to moderate weights than to do heavy weight lifting with limited repetition. Weight training will burn calories, increase lean body mass and decrease body fat which also affects cholesterol levels. At the same time, it can also strengthen bones, reduce back pain, and increase stamina and self-confidence.

A study in the Tufts University Diet and Nutrition Letter, July 1993, indicated that the average sedentary female is about twenty-five percent fat. By the time she is sixty-five, her body composition will be about forty-three percent fat. Sedentary men increase from eighteen to thirty-eight percent fat during the same time period. Between the ages of twenty and seventy, a typically sedentary individual will lose about thirty percent of his total number of muscle cells, which translates to a loss of six to seven pounds of lean body mass per decade. Even if a person does not gain weight over the years, he or she would still become fatter due to the loss of lean body mass and muscle in proportion to body fat. In light of this takeover of muscle by flab, it's easy to understand why people become frail as they age. In fact, many of the declines of aging come largely as a consequence of inactivity. That does not have to be the case. It's our choice.

Fitness takes time and effort, but it is a small investment compared to the returns. It frees us from a host of ailments. It fills life's cup to overflowing with vitality and a buoyant spirit. We augment the energy we get from the plant foods with the energy obtained through activity, and this exponentially multiplies the benefit to our entire state of health and well-being.

The following is a list of the growing number of athletes who practice the vegetarian way of life:

Henry (Hank) Aaron, major league baseball homerun champion
Ridgely Abele, world champion in karate
Betsy Beard, member of 1988 U.S. Olympic rowing team
Surya Bonaly, Olympic medalist in ice skating
Roger Brown, professional football player
Leroy Burrell, Olympic medalist in track
Joy Bush, powerlifting champion
Andreas Cahling, champion bodybuilder
Chris Campbell, Olympic bronze medalist in wrestling
James de Donato, world record swimmer
Jonathan de Donato, world record swimmer
Estelle Gray and Cheryl Marek,
world record cross-country tandem cyclists
Ruth Heidrich, Ironman triathlete, age group record holder
Roy Hilligan, bodybuilder
Desmond Howard, Heisman trophy winner
Billy Jean King, tennis champion

Killer Kowalski, champion wrestler
Carl Lewis, Olympic runner
Sixto Linares, triathlete
Bill Manetti, powerlifting champion
Edwin Moses, Olympic gold medalist in track
Martina Navratilova, tennis champion
Paavo Nurmi, long distance runner with twenty world records
Al Oerter, discus thrower and winner of four Olympic gold medals
Meghan O'Leary, bodybuilder
Gayle Olinekova, triathlete
Bill Pearl, four-time Mr. Universe, bodybuilder and author
Leander Paes, Junior Wimbledon champion
Bill Pickering, English channel swimmer
Stan Price, world record holder in bench press
Murray Rose, world record swimmer

(Source; Vegetarian Times, February 1994.)

SUNSHINE—LIGHT FROM THE HEAVENS

The harvest of sunlight captured in plant foods has been a theme throughout this book. This celestial star blesses our planet with life. In addition to washing the world with light, power, and warmth, its action is felt right down to the molecules within our body chemistry which work to enhance the health of body, mind, and spirit.

The sun provides ninety-eight percent of all the energy on earth. The other two percent is geothermal, originating in the earth's hot liquid core. Light is actually a relatively small portion of the immense energy the sun produces. We have already discussed the compelling life-promoting relationship among man, plants, and sunlight. The following is a thumbnail sketch of other ways in which sunlight affects our health and well-being. This list is drawn from work done by Doctors Agatha and Calvin Thrash at their Uchee Pines Health Institute in Alabama.

• Vitamin D is often referred to as the sunshine vitamin because it results from a sun-induced chemical reaction which converts cholesterol and ergosterol in the skin to vitamin D. Since this reaction utilizes cholesterol it reduces the stores of cholesterol in our body. Vitamin D plays a vital role in the absorption of calcium and utilization of phosphorus which are essential for strong bones and teeth. It is also essential in the thinking process.

• Sunlight works to increase circulation, the number and efficiency of blood vessels in the skin, and cardiac output. It also increases the oxygen-carrying capacity of the blood and enables oxygen to reach tissues and joints by direct

action and reflex action of the blood vessels. Thus it works in several ways to improve the circulatory system.

• Sunlight contributes to a number of ways in which body functions are regulated. It has been found to decrease blood pressure, although other factors contribute to blood pressure levels as well. It also plays a role in regulating blood sugar levels, and by means of its action on the eye, it affects the pituitary gland which controls hormone production of the other endocrine glands in a beneficial way.

• Sunlight increases the number of white blood cells and their capacity for fighting infection, and increases gamma globulin, which is part of the immune mechanism of the body. It promotes the healing of wounds and kills streptococci and other germs on exposure. Hanging your laundry outdoors in the sun to dry not only leaves clothes smelling fresh, but sanitizes them at the same time.

• Sunlight increases liver function and stimulates the liver to produce a drug-metabolizing enzyme which increases our ability to withstand pollutants in our environment.

• Sunlight increases muscle tone and endurance. It has been found that people who exercise in sunlight build muscle faster than those who exercise indoors.

• We are all familiar with the positive effect of sunlight on our mental outlook and sense of well-being. It counteracts depression, and lessens stress by working both through sensory receptors in the skin and well as by means of its psychological influence. As is the case with all good things, sunlight can become detrimental by means of excessive exposure. One does not need to lie in the sun for hours to obtain its benefits. Outdoor exercise, gardening, or other chores and activities will provide adequate sun exposure to reap these benefits. If you wish to sunbathe, avoid sunburn; begin with short exposures which gradually increase to about half an hour on both sides. Use an appropriate sunscreen. For some a hat may be helpful when outdoors for an extended period of time. Remember, the sun’s aging effects are cumulative. It will take years for the consequences of overexposure to be seen.

Be mindful of excess, but partake of the sun’s radiance whenever possible.

WATER—THE ELIXIR OF LIFE

The properties of water make it a remarkable and irreplaceable substance. In its vaporous form it is lifted from the ocean, desalinated, caught up to form clouds, and as such becomes the vehicle to distribute rainfall across the planet. It

is the energy of the sun which generates the wind to waft the clouds abroad. The precision of this dynamic mechanism maintains a model recycling system. The amount of water in our oceans and other major bodies of water has changed little since the beginning of time. It is possible that the same waters which once irrigated the corn fields of the Egyptian pharaohs and assuaged the thirst of Cleopatra or wise King Solomon, after purification, could fill your drinking glass today. Another life-sustaining quality of water is that, unlike many liquids which become more dense and heavier in their solid form, the molecular arrangement of water makes it become less dense. Thus when frozen it floats atop our oceans, lakes, and rivers, rather than sinking to the bottom. Imagine the devastating consequences if that were not the case.

Water has two special characteristics which make it an ideal body fluid. First, it is an excellent solvent. It will dissolve nearly any substance if given enough time. In terms of body function, it is much easier to transport materials throughout the body when they are dissolved in liquid. Second, water has a very high specific heat, which means it can absorb a great deal of heat before the water itself will rise in temperature.***127** This keeps our blood from actually reaching cooking temperatures when we exercise or participate in intense physical exertion. Our physiology, and in particular our blood circulation, is responsive to changes in temperature. The science of hydrotherapy utilizes the application of hot and cold water treatments as a means to activate the body's therapeutic response to water temperature, which in turn sets in motion the body's own healing ability. These procedures require precise temperature differentials coupled with specific timing and have largely become a lost art in an age of high-tech medicine.

Water is the most abundant component of the human body, averaging about sixty percent of body weight. The typical range is from forty to eighty percent. The difference in individual percentage is due to the distribution of lean versus adipose (fat) tissue. The percent of body weight from water decreases as the percent of body fat increases. The majority of this water weight is distributed between the fluids that fill the inside compartments of our 100 trillion cells and the fluids which bathe these cells on the outside. A balance must be maintained between the fluids on the inside and outside of our cells. Once again, the balance concept comes into play. Too little or too much water can cause cells to shrink or become swollen depending on which way the water balance has shifted—water leaving from inside the cell compartment to the outside would shrink cells and water flooding the cell from the outside would have the opposite effect. Generally these conditions do not develop. But cells, especially brain neurons, do not function properly when they are either shrunken or swollen.

Therefore, mental symptoms stemming from this imbalance and its consequent effect on cell function can range from confusion, dizziness, headaches, irritability and lethargy in mild cases to convulsions and coma if the condition is severe.***128** I mention this to again underscore the interrelatedness

of how our body functions. Everyone knows the kidneys have something to do with body fluids, but we may not automatically associate clear thinking and alertness with fluid balance. I have not seen it documented, but more than one teacher has suggested to me that if students would just drink more water they could counter sluggish thinking and improve their grades. Theoretically this makes sense because chemical and electrical impulse is necessary for brain cells, especially neurons, to communicate with one another, and water is the greatest contributor to the body fluids in which these transactions take place. That does not mean that simply drinking more water will make a scholar out of a poor student. However, it is safe to say that water is a contributing factor to alertness. Unfortunately, we tend to rely on artificial stimulants, such as caffeinated beverages and other chemical concoctions as the pick—me—ups of choice, many of which have pros and cons attached to their usage. Water has no such side or after effects. If you could hear your cells talking, water would be the ideal beverage of their request.

Water balance is not a trivial matter. Much of the kidney's work revolves around balance of the fluids mentioned above, the regulation of the critical acid-base balance, and the balance between water and salt, just to name a few of its numerous functions. The balance of these systems has an influence on such basic body functions as amount of urinary output, blood pressure, and heartbeat. The kidneys also monitor plasma fluid composition and determine what needs to be reabsorbed, recycled, or excreted. Water is nature's ideal purifier. The kidneys rely on it to remove toxic substances which are the natural waste products of metabolic processes or can be taken in through food, drugs, and from the environment. If these metabolic end products were allowed to accumulate they would be especially toxic to the brain. The marvel of nature's water recycling system in our external environment is duplicated with the body as well. The kidneys filter about fifty gallons of plasma fluid (composed primarily of water) daily. Considering that the average plasma volume in an adult is about 2.75 liters, this means that the entire plasma volume is filtered by the kidneys about 65 times per day.***129** If this water were not cleansed from impurities and reabsorbed back into the system you would have to replace it. Can you imagine having to drink fifty gallons of water a day? From this perspective, the six to eight glasses of water which are needed to maintain fluid balance is but a drop in the bucket. The body of a man weighing 150 pounds contains about 120 pounds of water. If this man were to drink only one pint (16 ounces or 1 pound) of water daily, it would take 120 days to renew the water in his body. He could cut this time in half by drinking two pints of water a day, but even at that, would you want to do your laundry in the same wash water for 60 days?***130** In a sense that is what we expect from our bodies when we overlook the importance of water as a medium for internal cleansing. Most people include a bath or shower as a part of their daily hygiene. What could be more ideal than nature's provision that the same substance used to clean up our exterior is also

that which takes care of our inside as well? Since body fluids are the mechanism by which toxins are removed, it is wise to keep that system replenished with an abundant, fresh supply of water to facilitate efficient removal of impurities. Water is the primary ingredient of our blood, and our blood is the life transport system for all body functions. Can we afford to be casual about its important role in maintaining optimal health? Of all health-enhancing habits, drinking six to eight glasses of water a day is one of the very easiest to attain. No other beverage comes close to it in value. It is purely and simply the best.

Many people have concerns about water contamination and choose bottled water because they believe it to be a less hazardous alternative. Whether water comes from a bottle or from the tap, it all originates in the same place—either from surface water or ground water. Surface water from lakes, rivers, and reservoirs supplies most of the more densely populated city areas. While it is susceptible to contamination by acid rain, pesticides, fertilizers, animal waste runoff, and industrial wastes, it has the advantage of moving faster than groundwater and being somewhat cleansed by aeration, exposure to sunlight, and filtration by plants and other microorganisms that live in it. These processes remove some, but not all contaminants. Ground water comes from aquifers and is susceptible to contamination from hazardous waste sites, dumps, gas and coal pipelines, landfills, and the downward seepage of surface water. It must percolate or seep through soil, sand and rock to reach the aquifer. Percolation acts as a filtering system for some contaminants, but again, not all.***131** Is one really better than the other?

Some object to chlorination of public drinking water. There can be mutagenic and carcinogenic by-products to this process. However, health officials generally regard the risks to be substantially offset by the diseases of microbial origin which it prevents. Lead contamination may be of greater concern. That does not occur at the treatment plant, but rather comes primarily from three construction-related sources: lead service pipes, brass faucets, and copper pipes connected by lead solder. In 1986, lead containing solder on pipes carrying drinking water was banned, followed by a ban on the use of lead in new pipe construction in 1989. To reduce lead intake from piping, you can run your water for about 2 minutes if the tap has not been in use for at least 6 hours, avoid softened water, and avoid drinking warm or hot water directly from the tap.***132**

Government regulation of bottled water is not adequately supported by consistent testing for contaminants in the water or routine inspection of processing plants. When thirty-seven brands of mineral waters, domestic and imported from nine European countries, were tested for levels of twenty-three metals, five anions, and acidity, researchers found large variations in composition among different brands as well as diverse composition from lot to lot within a single brand. Of the thirty-seven brands tested, twenty-four had one or more values which were not in compliance with U.S. drinking water standards.***133** It is also important to note that if your water is dispensed from a

water cooler it should be disinfected once a month by running half a gallon of white vinegar through it and removing the vinegar residue with a rinse of four or five gallons of tap water. The bacterial content of water coolers has been found to be considerably higher than government recommendations.***134** Contaminants aside, most people choose bottled water for its taste. Unlike tap water which is disinfected with chlorine, bottled water is treated with ozone, which leaves no flavor or odor in the water. It's debatable whether the virtue of bottled water actually extends beyond taste. Legal definitions for the labeling of bottled water are still forthcoming. A few guidelines may be helpful in making a selection of bottled water: check to see if the bottling company is a member of IBWA (International Bottled Water Association); that should be indicated on the label. Also factor in the water's original source—does it come from a public source, or if it comes from a spring or stream, where is it located? It could make a difference whether it comes from an agricultural, industrial, residential, or undeveloped area.***135** A home water filtering unit can be an effective and less expensive long-term option for minimizing contaminants, provided that maintenance instructions are carefully followed. As mentioned in the previous chapter, water contamination is based on several levels of lifestyle choices. If we want to purify our water, we must look at the entire picture. Whatever you do, make six to eight glasses of nature's elixir of life a part of your daily routine.

SLEEP—NATURE'S RESTORER

Sleep is much more than simply not being awake. It is an active process. It is a nightly voyage we take into the expansive, convoluted, dimly understood regions of our unconscious mind. The reasons for this nocturnal passage of the 24-hour cycle remain mostly a mystery to science. As is the repeated theme of our intricate physiological design, there is still much more to be learned about sleep. We do know that something important is happening during this darkening of our awareness because the entire body system changes during sleep—heart rate, temperature, kidney function, brain waves—all are altered. At least two very large studies of over one million participants each indicate a relationship between sleep and health. In one study the longest life spans were associated with about seven hours of sleep. That does not prove a causal relationship, but it does indicate that people who get that amount of sleep tend to live longer. The well-known Breslow study done in Alameda County, California, also identified seven health habits which contribute independently to better health and longer life. Seven to eight hours of sleep per night was one of the seven contributing factors.***136**

There are over 10 billion brain cells which create extremely active brain waves pulsating with electrical alacrity from all parts of the brain during our waking hours. These active, somewhat random waves are called beta waves. As we fall asleep we enter into a light sleep characterized by slower, more regular alpha waves which seem to wash over the entire brain surface. Brain waves slow

down even more in the delta phase of slow-wave sleep. As the night progresses we move in turn through four different phases of light to deep sleep. The body alternates between these sleep stages in predictable intervals, though the amount of time spent in the various sleep stages may differ somewhat from one individual to another.

Generally, most sleeping time is spent moving between deep and REM sleep. Slow-wave sleep contributes to about eighty percent of this nightly venture, and REM makes up the other twenty percent.***137** REM is named for its characteristic rapid eye movements. It is sometimes referred to as paradoxical sleep because brain waves during this time are very similar to those when we are awake.***138** If one could see the movements of the eye under the lid, the eyes would be rapidly looking side to side as well as up and down. This is dream sleep, and is vital in order to awaken fully refreshed. It is speculated that one's rapid eye movements may be following the action of his or her dreams.

It is curious that while the eyes are in perpetual motion, the rest of the body goes into a state of seeming paralysis from the neck down. In animal experiments it has been demonstrated that when the nerves which activate this muscle paralysis are severed, the animal seems to act out its dreams in body movements. A video presentation depicting this phenomenon in a cat graphically portrayed the cat acting out a range of activities from exaggerated leaps to running and crouching as though it were chasing butterflies or stalking prey.***139** Who knows what our own activity would be if we were not confined to our beds by this temporary paralysis?

It is thought that dreams may be a way of sorting and organizing our experiences. REM sleep is also the stage of sleep in which heart rate, respiration, and blood pressure are altered. During this time the body uses more oxygen, the pituitary gland is stimulated, cerebral blood flow increases, and there is a rise in the temperature of the brain.***140** A specific amount of REM sleep seems to be required for our health and well-being. Researchers have discovered that hallucinations result when individuals are experimentally deprived of REM sleep for a night or two. This same research indicated that when the subjects were allowed to sleep without being awakened on subsequent nights they spent proportionately more time in REM sleep as if to make up for the lost time.***141** Another study showed that when people are deprived of sleep for long periods, they seem to have special psychotic episodes which coincide in cycle time to their missing REM sleep intervals. Barbiturates and alcohol can suppress REM sleep.***142** Sleep deprivation in general can have dire consequences. A colleague once related an interesting research incident regarding sleep in which young men at an eastern university were paid to go as long as possible without sleeping. The winner went ninety-six hours, four twenty-four-hour days. He got his money, but his brain slowed down for more than four months. He had to repeat his entire senior year in college.

One of the most crucial tasks taking place during sleep is that of restoration and repair. The body needs rest to successfully accomplish this task. When you exercise, muscle tissue is broken down, and it is during sleep that these tissues are built up and restored. Hormones and other forms of energy stores are depleted during the day and take time to be replenished. The RNA in cells becomes depleted periodically and requires rest to be restored.***143** RNA and DNA are both compounds which enable genetic information to be stored in living cells and passed on to future generations. DNA is found within the cell nucleus and RNA is contained within the cell fluids outside of the nucleus. Since sleep is a time of physical rest, larger quantities of oxygen are available to assist in these restoration processes because it is not being diverted to energize physical activities.

Many people greatly underestimate the value of sleep as a contributor to the optimal functioning of our immune system. This fact should be evident from our own experience with needing to sleep more to recover from an illness, even when countering the common cold. The nervous system especially needs a full complement of sleep to be at its best. The endocrine glands, so important in stress control and vigor of the body, have schedules—regular times to expend energy and regular times to build up and rest. That is why one senses an energy slump and may feel irritable or depressed without proper rest. The body is letting you know that you have put it into a deficit condition. A study reported in the November 1994 Tufts University *Diet and Nutrition Letter* found that weight control experts may have overlooked a potentially significant factor: too little sleep. A small body of intriguing research shows that when subjects had either less than three hours of sleep or interrupted sleep for three nights in a row, all reported a greater appetite, varying from slight to marked increases. In another study of young men deprived of REM sleep for several nights, five developed a marked increase in appetite and three gained a few pounds. Explanations for this data range from the obvious fact that more calories are being utilized when one is awake than asleep to theories derived from animal research which indicate that lack of sleep disrupts the body's temperature setpoint or process of heat regulation or both, thereby increasing caloric need.

It cannot be concluded that lack of sleep will make one fat, but it can be said that people who are tired eat more, and more often. Another study reported in the December 1992 University of California at Berkeley *Wellness Letter* stated that loss of sleep results in decreased mental performance. Even the loss of one night's sleep is likely to result in fatigue, irritability, inability to concentrate, and mood shifts. Creative thinking and the ability to deal with unfamiliar situations are also diminished by lack of sleep. The disruption of both circadian rhythm and one's sleep cycle are most likely overlapping contributing factors to the consequences of sleep loss.

It is easy to cut corners on sleep. Some have suggested that the national debt would pale in comparison to our sleep deficit. Sleep needs vary according to age

and the individual. It has been theorized that sleep is necessary to allow the brain to accomplish the long-term structural and chemical adjustments necessary for learning and memory. That may be one reason why infants require so much sleep and why seniors require less.***144** We know for a certainty that lack of sleep diminishes creativity, mental acuity, efficiency and vitality. There are many more physiological consequences of sleep loss which we are still seeking to understand.

Most of us cut short our full complement of sleep in order to gain the time to do something else which we perceive to be more important. That probably says more about our priorities than anything else. If we are already living an overextended, stressfilled life, then certainly the logical solution is not to diminish the very time our body needs to be restored. Everything goes back to the importance we attach to taking care of ourselves. We cannot put our health on hold without holding back the life-promoting results of cooperating with nature's wisdom.

PREPARATION FOR SLEEP

The following is a list of suggestions on how to prepare for sleep, adapted from the July 1992 issue of the University of California at Berkeley *Wellness Letter*. Readiness for sleep sets the stage for a good night's rest. In a recent study one group of insomniacs was treated with Halcion (a tranquilizer), while another learned to do some muscle relaxation combined with the steps listed below. At first the Halcion group got more sleep. However, the other group had caught up by the second week, and by the fifth week the behavior-training group was both falling asleep faster and sleeping better than the group using Halcion. Here is the program for sleep they were given:

1. Go to bed and get up on a regular schedule.
2. If your sleeplessness stems from worry or grief, try to correct what's bothering you, accepting that you may not be able to change your situation overnight, but by taking one step at a time positive changes can be achieved. A pastor, counselor, or trusted friend may provide support through the difficulty.
3. Don't drink alcohol before bedtime—and don't smoke. Alcohol can disrupt sleep patterns and make insomnia worse. Nicotine also contributes to wakefulness.
4. Avoid eating a heavy meal in the evening. The evening meal should be the lightest of the day. Don't drink large amounts of liquid before retiring. In addition to the discomfort of having a heavy meal sitting in the stomach to be digested, the process of digestion requires energy; energy utilized in this way detracts from the energy needed to fuel the process of repair and restoration vital to optimal body function.
5. Eliminate caffeinated beverages.
6. Avoid daytime naps, even when you are tired.

7. Spend an hour or more relaxing before you retire—read. listen to music, or take a warm bath. Try to fill your thoughts with something that will soothe and uplift mind, body, and spirit.

8. If you are unable to fall asleep after twenty minutes, get up and do something rather than lying there trying to fall asleep. But don't bring work to bed. If you wake up in the middle of the night and can't fall back to sleep, try reading for a short time. Meditation, counting sheep (or flowers, or whatever appeals to you) or reconstructing a happy event or narrative may lull you back to sleep.

9. Avoid reproaching yourself. Don't make your sleeplessness a cause for additional worry. Insomnia is not a crime. Sleeping exactly eight hours is sometimes not possible. Avoid setting up a chain of thinking in which frustration and anxiety keep you fretting over lost sleep.

10. Avoid being a clock watcher. Turn the clock to the wall if you can't help looking at the time and worrying.

If these commonsense tips don't work the first night, they may start working over a week's time.

FOOD SELECTION GUIDELINES

There was a time when the Four Food Groups were the standard guide for meeting nutrient requirements. That standard has recently been replaced by the Food Pyramid guide. This pyramid is often included as a part of the product information on numerous packaged foods. I have also seen it printed on grocery bags. By now it has probably become familiar to most people. The guidelines included in the pyramid follow the suggestions made throughout this book.

Eat liberally of grains.
Eat generously of vegetables and fruits.
Eat moderately of protein foods.
Eat moderately of calcium foods.
Eat sparingly of fats, oil, and sweets.

It is a challenge to devise an eating plan which applies to everyone and which does not become outdated as we continue to understand more fully the dietary aspects essential to our health and well-being. Food preferences and calorie needs vary from one individual to the next, but the Food Pyramid does serve as a reminder that we must keep nutrient requirements in mind as we plan meals and purchase food. We are eating not only to satisfy hunger and taste, but to provide the nutrition essential for health and vitality. Eating adequately of grains and protein is generally not a concern. The two most common reasons why many people may fall short of meeting nutrient needs is that they do not eat a wide enough variety of foods and they do not eat enough fruit and vegetables,

especially the green leafy vegetables. In turn that may lead to getting inadequate amounts of vitamins and minerals.

Throughout this book I have focused on nutrient-dense foods. It is helpful to think in terms of what foods provide key vitamins and minerals and then to devise meals around those foods. The body needs a daily feast of the protective nutrient chemicals we have discussed, not just an occasional treat. Being mindful of the nutrient value of foods should become second nature as we learn more about eating for health.

The charts in the following pages provide information about serving sizes and which foods are included in each of the food categories listed above as part of the Food Pyramid eating plan. The remainder of this section offers methods you may find useful in evaluating your caloric needs and dietary habits.

Be especially mindful of the serving sizes. That is a key factor in weight management. Some people question how many calories they require daily. Many nutrition sources use the general range of 2000 to 2200 calories per day for women twenty-five to fifty years of age and 2000 calories or less for women over age fifty. Men between the ages of twenty-five to fifty can assume about 2700 to 2900 calories daily. After age fifty, requirements lower to 2300 or less. “Active” teenagers could eat from the lower to 2300 or less. “Active” teenagers could eat from the higher end of the calorie range for the twenty-five to fifty age group. For those who would like a more individualized method to determine how many calories are needed daily, the following method offers a criterion based upon one’s activity level:

Food Groups	One Serving Equals One Item	Food Choice Examples	**Nutrient Contributions**
Whole Grains Servings Daily: **6-11**	1 slice bread (30 gin) 1/2 cup hot cereal (100 gin) 1cup dry cereal (30 gin) 1/4 cup granola (30 gin) 1/2 cup rice or pasta (100 gin) 1 tortilla (30 gin) 1 chapati (30 gin) 1/2 bagel or English Muffin (30 gin) 3-4 crackers (30 gin) 1/2 muffin (30 gin) 1/2 cup cooked beans (100 gin)	Grains: oats, brown rice, barley, millet, bulgur wheat, rye, corn, whole wheat, muti-grain, etc.	Complex Carbohydrates Fiber Protein vitamin B_1 (Thiamine) vitamin B, (Riboflavin) vitamin $B_6$and Niacin Iron Magnesium Calcium Trace Minerals
Vegetables Servings Daily: **3-5**	1 cup raw, leafy vegetable salad (50 gin) 1/2 cup chopped raw vegetables (50 gin) 1/2 cup cooked vegetables (80 gin) 3/4 cup vegetable juice (180 gin)	Vegetables: broccoli, kale, cabbage, collards, spinach, pumpkin, carrots, winter squash, sweet potatoes, potatoes, parsnips, rutabagas, turnips, tomatoes, beets, eggplant, okra, summer squash, cauliflower	Fiber Potassium, Calcium, Magnesium Beta-Carotene Folate vitamin C
Fruit Servings Daily: **2-4**	1 medium, whole fruit (100 gin) 1/2 cup canned fruit (125 gin) 1/4 cup dried fruit (100 gin) 1 cup berries (100 gin) 3/4 cup fruit juice (180 gin)	Fruits: oranges, grapefruit, lemons, apricots, peaches, nectarines, plums, persimmons, apples, pears, kiwi, papaya, mango, pineapple, bananas, strawberries, raspberries, blueberries Dried Fruits: raisins, dates, pears, pineapple, prunes, peaches, figs	Vitamin C Beta-Carotene Fiber Potassium Folate Magnesium

Legumes, Nuts, Seeds, Meat Alternatives Servings Daily: 2-3	1/2 cup cooked beans or peas (100 gin) 1/2 cup tofu (100 gin) 1/4 cup seeds (30 gin) 1/4 cup (1 oz) nuts (30 gin) 2 Tbsp. (1 oz) nut butter (30 gin) 1/4 cup meat alternative (30 gin)	**Legumes**: pinto, black, white, navy, kidney, cranberry beans, soybeans, garbanzos, lentils, blackeye, green pea, split pea, peanuts **Nuts**: almonds, walnuts, filberts, chestnuts, brazil, pecans, cashews **Seed**: pine nuts, sesame, sunflower, pumpkin **Alternatives**: tofu, meat alternatives	Protein Zinc Iron Fiber Calcium Vitamin B, vitamin E Niacin (B_3) Linoleic Acid
Calcium Group • Soybean Products • Green Leafy Vegetables • Fortified Alternatives Servings Daily: 2-3	1/2 cup cooked soybeans 1/2 cup tofu 1/2 cup soy cheese 1/2 cup cooked amaranth 1 cup soymilk (fortified) 1 cup green leafy vegetables (may be fresh or frozen) calcium enriched orange juice 1/2 cup white or black beans	**Soybeans**: whole cooked soybeans, tofu, soymilk, soy cheese, tempeh **Green Leafy Vegetables**: collards, beet greens, kale, broccoli, turnip greens, bok choy, mustard and dandelion greens **Legumes**: white, navy, great northern, black turtle beans Fortified Alternatives	Calcium Protein Vitamins A and D B Vitamins Vitamin B_{12} Fiber

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<tr>
<td>Eat Sparingly

Vegetable Fats and Oils, Sweets, and Salt</td>
<td>These foods such as salad dressings and vegetable oils, margarine, sour cream, cream cheese, sugars, soft drinks, candies, and sweet desserts provide calories and are low in nutrients. Vegetable oils contain essential fatty acids, but use them sparingly as they are high in calories. For every tablespoon of fat added to a 2200 calorie diet, you increase the percentage of calories as fat by approximately 5 percent. Every tablespoon of sugar adds 2 percent calories as sugar.
•Use visible fats sparingly
1 Tbs. margarine = 11.4 gm fat 102 calories 0 mg cholesterol
•Limit desserts to two or three per week
1 Tbs. butter = 12.0gm fat l08 calories 33 mg cholesterol
•Use honey, jams, jelly, corn syrup, molasses, sugar sparingly

1 Tbs. Mayonnaise = 11.0 gm fat 99 calories 4 mg cholesterol
•sparingly
1 Tbs. sour cream = 3.0 gin fat 30 calories 5 mg cholesterol
•Use soft drinks and candies very sparingly, if at all
1 Tbs. cream cheese = 5.0 gin fat 52 calories 15 mg cholesterol
•Limit foods high in salt
1 Tbs. cream = 15.0 gm fat 52 calories 21 mg cholesterol
l tsp. salt(5gm table salt)=2000mg sodium
1 Tbs. sugar = 12gm 48 calories
1 Tbsp. oil = 13.6 gm fat, 120 calories
l tsp. sugar = 4gm l6 calories
1 tsp. Oil = 4.5 gin fat, 40 calories
1 Tbs. honey = 21 gm 64 calories</td>
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<td colspan="2">Please Note:

• To allow for varying caloric needs there is a range of serving sizes for each food grouping. Older adults, inactive individuals, and many women may choose to eat on the low end of this range. Teen boys and active adults need to eat on the high end of the range. Most other individuals can meet caloric needs by choosing from the mid-range of daily servings.
• Keep in mind that some foods fit into more than one food grouping—such as green leafy vegetables. If you select one of the leafy greens to help fill your calcium requirement on a given day, that same serving may not also be used to contribute to your vegetable requirement—unless you eat enough to equal two serving portions. Foods may overlap among groups, but to meet nutrient needs you must eat the number of servings recommended in each separate group.</td>
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Your activity level	Calories needed per pound
Inactive	12
Lightly active	15
Moderately active	16—20
Very active	21—25

To find out approximately how many total calories you need per day, multiply your desired weight (which may not be your actual weight) by the number that corresponds with your activity level. Example: An inactive person whose desired weight is 170 pounds should multiply 170 x 12 to get 2,040 calories needed per day.

Source: *The Physician and Sportsmedicine,* vol. 19, no. 8, as reported in the Hope Health Letter, January, 1993.

If you are interested in the recommended percentage of calories which each major nutrient should contribute to total calories or how to figure out gram requirements, the following World Health Organization guidelines may be helpful.

Protein—l0 to 20 percent of calories. To figure your RDA in grams, multiply body weight in pounds by 0.36.

For example, 110 lb. x .36 = 40 grams of protein per day.

Fat—Zero to 10 percent of calories should come from saturated fat. As mentioned earlier, saturated fat comes dominantly from animal sources. Total fat intake should range from 15 to no more than 30 percent of calories. To figure grams based on the maximum of 30 percent, you can simply divide your daily caloric need value by 30. This can be simplified by dropping the last digit of your total daily calories, then dividing by 3. For example:

2000 total calories becomes 200 divided by 3 = 67 grams fat per day.
2500 total calories becomes 250 divided by 3 = 83 grams fat per day.

Remember that this result would be the upper limit. Unless you are very active, it would be advisable to eat less fat than that. In addition to eliminating animal products in the diet, one can also cut fat by going easy on dressings and the oil that is used in baked goods. Salsa makes a pleasing dressing substitute as does lemon and garlic, or orange juice combined with a bit of honey, fruit sections, chopped nuts, and seasonings to suit one’s taste. Vegetables, fruit, and legumes can be pureed to form a dressing base and seasoned to create a wide array of dressing alternatives. Your imagination is the limit. Not every combination is a winner, but it’s fun to experiment. It is also a rule of thumb that fruit puree, such as apple or pear sauce, can be used in place of oil in baked goods. Sometimes it cannot be substituted entirely, but generally you can reduce

the oil to only a quarter of the recipe amount and use puree for the rest. More often than not the oil can be totally eliminated.

Carbohydrate—50—75 percent of calories should come from complex carbohydrate. Less than 10 percent of calories should come from refined sugars. Since complex carbohydrates are the dominant source of fiber in this diet, that translates to about 27 to 40 grams of dietary fiber daily. In general, complex carbohydrate is the body's preferred fuel; the ideal is to eat toward the high end of the range. Grains, fruit, and vegetables form the broad base of the food pyramid guidelines. As mentioned in an earlier chapter, it is relatively easy for fat to become excess body fat, and more difficult for complex carbohydrates to be stored as excess fat in the body. To reiterate, that has to do with molecular structure and chemistry. Food fat and body fat are quite similar. You will recall that triglycerides are the main fat in food, and that they are also the major form of stored body fat. To convert a molecule of food fat to body fat requires only a few steps: disassemble the triglycerides to their basic parts, absorb the parts, and put them back together again. To convert a molecule of sucrose (simple table sugar, a disaccharide composed of glucose and fructose) the body has to split the glucose from the fructose, absorb both monosaccharides (single sugars), dismantle them into small fragments, then assemble the fragments into fatty acid chains, and finally attach them to the structure which makes them into a triglyceride.

In general, it requires about eight times the amount of ingested calories to convert carbohydrate to fat as to convert dietary fat to body fat. The body prefers the most energy-efficient method: fat to fat.***145**

Now, lest it seem I am saying that one need not be concerned about sugar intake, I will add a counterpoint for balance. Carbohydrates eventually break down into glucose, a simple sugar, within the body. As already stressed, carbohydrate is the preferred body fuel. However, table sugar, which is a refined carbohydrate, can create havoc in the system when eaten in excess. Excess fat and sugar often result in being overweight and obesity. Most people are concerned with carrying too much weight because it creates physical and psychological discomfort, but even more significantly, being overweight is a contributing factor in many disease processes. It is implicated in both heart disease and cancer as well as adult-onset Type II diabetes. When we study Type II diabetics we learn more about what causes the relationship between insulin and glucose to malfunction. Insulin opens the door for glucose to enter the cells. There are receptor sites on our cells specifically for this purpose. In the case of Type II diabetes these insulin receptors are greatly reduced in number, and cells can't get the glucose they need to fuel their work. Obesity causes cell membranes to malfunction. Insulin binds to these receptor sites only half as well in obese as in thin people.***146** Studies indicate that insulin is normally released in pulsating intervals of about twelve to fourteen minutes. The body strives to

maintain a stable blood glucose level. Diabetics do not have this normal rhythm, but rather demonstrate insulin pulsations which are irregular and erratic. When excess pounds are lost, patients regain insulin sensitivity.

Snacking or irregular eating habits or both may also upset the regular pulsation intervals which characterize insulin secretion. The body prefers regularity in our habits. There is a wide range of dietary habits with the potential to act as contributors to reduced insulin cell receptors. These include overeating, use of alcohol and sugar, being overweight, eating too great a variety of food at one meal, eating highly refined or concentrated foods in large quantities, eating between meals, late night meals, flesh foods, eggs, and dairy products.**[*147]** Bear in mind that insulin is a hormone, and as previously discussed, excess dietary fat influences hormones. Thus a low-fat diet and exercise are the prescription for improving this adult-onset form of diabetes. Obviously, both of these factors contribute to weight loss.

It seems that excess in general has a negative effect on our body systems. We have seen that excess protein contributes to calcium loss, and we also have evidence that excess sugar may influence insulin and other hormones as well. No matter what angle we choose to examine, it seems that concentrated sources of calories, whether they be from fat, protein, or refined sugars, disrupt the balanced interplay of nutrients vital to optimal body function. One of the ways we continue to learn about the implications of excess refined sugars is by studying various populations and what happens to their health as a result of prolonged dietary changes, in much the same way as we learn about the effect of dietary fats. Here is what we have found out about the influence of excessive sugar intake and the development of Type II diabetes among the Pima Indians, Yemeni Jews, and the Eskimos.

In each of the population groups, diabetes was unknown while they lived according to age-old traditions in their natural habitat. Due to their westernized reservation lifestyle, 60 to 70 percent of adult Pima Indians are overweight and half become diabetic.**[*148]** That is attributed to concentrated calories of both fats and sugars. In the case of the Yemeni Jews and Eskimos, changes seem to be more related to excessive sugar intake. The Yemeni Jews lived a regulated lifestyle consisting of mostly herding and a simple diet which included almost no refined sugars. When they moved from Yemen to Israel to escape political conflict, they made two significant lifestyle changes: increase in sugar consumption and decrease in exercise. Both of these contributed to heavier body weight. After twenty years of living in their new homeland, one out of five Yemenites over age thirty is diabetic.**[*149]**

The Eskimos have always been noted for a high fat, high protein diet, since a large part of their menu comes from animal products and their climate does not provide for many fresh fruits and vegetables. Yet even though this kind of diet is often associated with Type II diabetes, it was not previously a problem among the Eskimos. Studies done by Dr. Otto Shaefer, who worked as a physician

among the Eskimos for twenty years, revealed dramatic changes in disease patterns during the time he lived among this population. In 1959, the average Eskimo consumed about 26 pounds of sugar per year. In 1967, that jumped to about 104 pounds yearly—close to present U.S. individual sugar intake, though some U.S. estimates dip as low as 65 pounds per individual yearly. In the earlier years, most of the Eskimos ate more unrefined, starchy carbohydrates like cereal, breads, and grain, with little carbohydrate in the form of refined, processed sugar. By 1967 that was no longer true. The opening of the Alcan Highway and the location of air bases in Alaska and Canada brought a heavy westernizing influence upon Eskimo dietary habits. They seemed to uncover an almost insatiable sweet tooth—which by now was becoming a decayed tooth. Their appetite for sweets was such that it was common for mothers to put nipples on pop bottles so their babies could suck soda throughout the day. Eskimos were getting taller, heavier, and going through puberty earlier. In forty years, the age of puberty among girls dropped from eighteen or nineteen to age eleven.

Dr. Shaefer believes the “sugar explosion affected the entire endocrine system including thyroid, growth hormone, and the gonadal hormones of men and women, causing earlier maturation.”***150** It is also his opinion that more store-bought processed food with a high concentration of sugar and fat was contributing to the early menarche. Studies indicate that the earlier one goes through puberty, the earlier one dies. To speed up the process of maturation is clearly not an advantage. Diabetes tripled in Alaska and Greenland in only a decade’s time. Gall bladder disease, also unknown prior to 1950, has become the most common reason for surgery among the Eskimos.***151** Adding excessive sugar to an already high fat diet has taken a very sad toll on Eskimo health.

Pima Indians, Yemeni Jews, and Eskimos are all susceptible to inbreeding, which multiplies genetic predispositions to disease, but it has also been shown that if these people do not become overweight they generally do not develop diabetes.***152** Lest it sound as though the populations mentioned represent isolated problems and are particularly genetically prone to Type II diabetes, I must add that since 1960 the incidence of diabetes has doubled in Venezuela, Austria, Switzerland and Italy, and has almost tripled in Japan.***153**

It is easy to read about the problem of adult-onset diabetes and dismiss it as irrelevant if it does not apply to you. But the point I would like to make is that all of our lifestyle diseases, whether heart disease, cancer, or diabetes develop over time and are often unknown to the victim until serious symptoms call attention to the problem. The interplay between insulin and glucose does not generally malfunction overnight. The general symptoms which may come and go as the disease develops, such as headaches, fatigue, mental sluggishness, digestive system problems, or depression, can easily be attributed to simply having to cope with the stresses of living, rather than recognizing that dietary factors are contributing to these conditions. The body tries to adapt until it can

no longer do so. Excess, in the form of fats, sugars, protein, or just plain eating too much puts a burden on metabolic and digestive systems. And what taxes these systems will inevitably influence the brain. Wide mood swings are a part of both diabetes I and II. These fluctuating moods can occur without having to be diagnosed as diabetic. Our mental state is always subject to physiological influences. This snapshot of diabetes is intended to be a reminder that we manipulate our well-being on every level—physically, intellectually, emotionally, and spiritually—by what goes into our mouths. Use the concepts from the food pyramid overview and the additional dietary information in this section as guidelines for eating wholesome, life-promoting foods. Eat healthfully, happily, and temperately.

IN CLOSING

Just as there are physical laws which govern the natural world there are principles which govern our well-being. We have made an attempt to identify these guidelines for vibrant living. The following is a brief summary:

1. Develop dietary habits which are centered on plant foods, keeping in mind that the ideal is food as close to its natural state as possible. Plants are the storehouse of the sun's life-sustaining energy. They become the medium by which the power of light is converted to chemical energy within our bodies. Eat with an eye toward the nutrient value of your food and what is needed on a daily basis to provide balanced meals. Make meals pleasant and at established times.

2. Stay active and fit. Exercise regularly and do it outdoors as often as possible. A minimum of thirty minutes of activity, three to four times per week is necessary to "maintain" fitness. For greater benefits you will need more than the minimum. Exercise oxygenates the system, maintains muscle which burns calories most efficiently, and bolsters our physical strength, stamina and adds endurance. Outdoor activity also permits an opportunity to take in the benefits of life-promoting sunlight. Wholesome food choices along with consistent exercise provide optimal energy.

3. Drink freely of water, the elixir of life. It refreshes and purifies the body systems. It is nature's beverage of choice.

4. Get enough sleep. A full complement of sleep is necessary for a healthy immune system, for building and repair of body systems, and for optimal mental acuity and a buoyant emotional outlook. To short-change yourself here means coming up short on your physical, mental, and emotional resources to meet the challenges of daily living.

5. The body is designed as a composite of several interrelated systems. Whatever we do affects all body systems. A burden on the stomach taxes the entire system. Intemperance, the inability to exercise self-restraint or moderation, leads to an overall imbalanced body system. Habits which do not promote the healthful action of our physical body take their toll on our thoughts and emotions and thereby render us less capable of achieving optimal mental, emotional or spiritual development. Improper care of the body has a beclouding influence on all of our higher faculties. We cannot escape the fact that the chemistry which we create by our food choices dictates our total physiology, our well-being—body, mind, and spirit.

6. The mind was designed to govern our body, not vice versa. It is our mind which must evaluate, discriminate, and bring into play those powers of judgment which permit us to attain our goals and guard our personal values even when they are pitted against harmful natural inclinations. Just as a muscle grows weak without use, our strength of self-mastery also diminishes without consistent usage or placing demands upon ourselves which will require meeting new challenges.

I will conclude with an observation from one of my favorite authors. She lived over 150 years ago, yet her sagacity seems to sharpen with the passage of time. In 1898 Ellen G. White wrote in a letter that “There are but few as yet who are aroused sufficiently to understand how much their habits of diet have to do with their health, their characters, their usefulness in this world, and their eternal destiny” (*Counsels on Diets and Foods*, p. 52).

I can’t help thinking that the tone of this passage was hopeful as she looked to a future in which there would be a more comprehensive understanding of how the human body is designed and what is necessary for man to care for it in a way which will accomplish the greatest good.

6

Epilogue — Light And Enlightenment

IN CONCLUSION, let us go back to the beginning—the Genesis unfolding of an ideal life-sustaining provision for man to develop his highest purpose, full potential, and robust longevity. There are some who read the Bible from a mythic or symbolic perspective rather than as the inspired Word of God. Regardless of whether this enlightening account from antiquity is interpreted for its symbolic meaning or taken in a literal sense, there are striking and intriguing parallels between what we find to be true today and the truths the ancients carefully preserved to be passed on to future generations.

Genesis opens with the creation of light and asks us to consider where the light of life has its origin. Your answer to this most profound of all philosophical questions will determine the template you place upon all of life's experiences. We know today that life could not exist without sunlight and that light generates power. This solar power is converted into a chemical and electrical means of keeping the human body vibrant. The fascinating aspect of the opening verses of Genesis, often overlooked by a casual reading, is that the light which pervades the void darkness of a lifeless planet does not emanate from sunlight; sun, moon, and stars are not described until later in the text. Science does not fully understand the properties of light, nor can it offer anything beyond conjecture regarding the origin of the sun's energy and what sustains its imploding and exploding combustion. We do know that the process of photosynthesis, which man fully understands yet cannot duplicate, has been put in place to capture the life-sustaining power of light and pass it on to us. It is intriguing to consider that possibly a part of what makes light and the sun's fiery energy something of an indefinable essence may be related to its inception as an element of an omnipotent Creator's life force. Why are inhabitants of heavenly origin always depicted as powerful beings robed with garments of light? Does that just make for captivating imagery? Or could it be that life potency is perpetuated by conformance to the Creator's original intent that all created beings find their most elevated purpose by means of life-enhancing habits designed to develop mind, body, and soul according to a divinely appointed plan based on wisdom and benevolence?

Was it just happenstance that in the Creation account man was placed in a garden? It strikes me that the Garden of Eden is the paradigm for life. Gardens breathe life and are natural places of growth. With all that has been presented throughout this book, and what we continue to learn about the life-sustaining benefits of plants, it makes perfect sense that this setting would be the ideal one for man to inhabit peacefully, productively, and healthfully. At that time the potential for man's personal development and growth was almost limitless.

There was no death in Eden, no spilling of blood. Man's diet was entirely plant based. That was the original life promoting diet. Man's full-time occupation was caring for the earth. Every square inch of his environment was to be as rigorously protected as though it were his own private palace. He was given stewardship over the animals; that did not include eating them. We discover as we read through Genesis genealogies that this lifestyle sustained health and longevity in a way which has been unsurpassed throughout the written record of history.

As we continue in the Genesis record, we find that it was not until after the Flood, when plant life had to be replenished, that man was given permission to eat animals. And even that had restrictions. The Hebrew health code did not permit that the blood or the fat of any animal be eaten, and in addition specific kinds of animals were designated as unsafe to be eaten at all. Is it merely coincidental that it is an animal's blood and fat which carry contamination, and that science today warns us of a myriad of diseases related to the consumption of animal fat? In the book of Deuteronomy, Moses recounts the health code given to the Israelites and punctuates the summary of these statutes by indicating that adherence to this code was to be their wisdom, and would lead other nations to say, "Surely this is a wise and understanding people." All we have to do is to look at the escalating costs of medical care, the problem of finding ways in which all people can have equal access to whichever health care system we devise, as well as the tragic number of needless deaths related to lifestyle incurred diseases, and we begin to catch a glimpse of what Moses meant. If there were to be a people who had robust health and vigor well into old age, and who needed little medical intervention to maintain this enviable condition, would it not seem that they had indeed discovered the elusive fountain of youth? Wouldn't we want to share their secret? That we continue to find the quest for health and longevity compelling, is evident in the bountiful research that has been done on those populations which have fewer health problems and live longer than is considered to be average. There have been over 200 studies done on Seventh-day Adventists alone, due to the large number of vegetarians among them and the fact that they live longer and suffer from fewer lifestyle related diseases, such as heart disease and cancer, than the typical population. We may protest the Eden philosophy by asserting that we no longer live in such an ideal circumstance or that it is ingenuous to believe such a place ever really existed. Whatever your individual viewpoint, it is difficult to deny an omniscient Intelligence behind the interconnectedness between man and nature. Numerous scientific studies being done at this very moment reinforce the benefits of an Eden-style plant-based diet to maintain health, personal well-being, longevity, and the survival of our planet.

In the Genesis account man was clothed with light which illuminated his understanding and served to connect man to his Creator in willing allegiance. From a surface reading of the story, Eve, the serpent, and the forbidden fruit

may seem only a picturesque way of conveying temptation, but ponder a moment how carefully any enemy must consider what strategy will be employed to set the stage for a victory. The name of this enemy, Satan, Abaddon, or Apollyon is interpreted to mean, Destroyer. Can we really believe that appetite as the chosen medium (weapon?) of demise was but a spontaneous, split-second decision, rather than a carefully thought-out master plan? Can we avoid the disturbing possibility that this enemy was aware of the chain of woeful circumstances which would follow from something as seemingly innocent as one's choice regarding what is to be put on his or her plate? Isn't that precisely what deception is all about— being subtly misled into believing a partial truth or a total lie? Not only have we been misled in making food choices which violate the original design to keep both man and the planet healthy, but the epitome of this deception comes in our blaming the God of creation for the weight of suffering which comes as a consequence of generation after generation following in this pattern of violation. The challenge of the Eden story is the multiplicity of layers one can uncover m seeking to understand its full meaning and in applying its wisdom to present day circumstances. Observation and experience tell us that appetite has enormous repercussions. The more reckless we become about effacing creation in the way we choose to care for our own bodies and the environment in which we live, the more dire the consequences. We work at counterpurposes to destroy not only our own health, but the health of our planet's ecosystem and the health legacy we pass on to future generations as well.

Take a few moments to thoughtfully evaluate the implications of what you choose for nourishment. Consider what standards or criteria govern your behavior. As mentioned in the opening chapter, for many people food choices are simply a matter of taste. In the Eden depiction we find that Eve relied on her senses as the sole criteria for eating of the forbidden tree. The invitation sounded appealing and the fruit was pleasing to the eye and taste. Our senses alone are not always a complete standard upon which to make an accurate evaluation. Within the sphere of food selection come such issues as education, self-discipline, and personal effort. Is our personal health and what happens to the planet we live on worth the effort it may require to retrain our tastes, to educate and expand our thinking, and to discipline ourselves to transform our goals into reality? Might there be a relationship between how we apply these factors to health choices and our ability to effectively use these tools to press the limits in other areas of our lives? A life of self-indulgence and immediate gratification may appeal to many, but what virtues or life skills are to be gained from this path?

We hear so much about teaching our children how to be critical thinkers, to be responsible, to respect themselves, and to consider the long-term consequences of their actions. In what area of life do we have more ample opportunity to develop those skills than in choosing how we will eat and care for

the health of our bodies? We must eat to live. Choices about what we will eat are made several times daily from infancy on. Within the scope of those choices lies the necessity to think for oneself and to critically evaluate how one will care for his or her well-being independently from what others may be doing. These choices in turn reflect individual self-respect, personal values, judgments about one's responsibilities, and the ability to make wise decisions with long-ranging implications.

It has been the purpose of this book not only to present the burgeoning body of evidence which underscores the life-promoting characteristics of plants and the advantages to be gained from vegetarianism for both the individual and for our planet, but also to create a philosophical frame around the way in which appetite becomes a thread which weaves its way into all that we do as well as into all that we are.

Though man has walked through several centuries since the Genesis record, human nature has changed little. We still are faced with choices which fall within the spectrum of two opposing master plans—one based on respect for all life, designed to sustain our health and well-being on every level of personal development and which beckons our highest and most worthy aspirations, and the other which erodes life and eventually colors the entire earth with the negative results of compromise, avarice and pillaged personal and ecological resources. The sun bathes our planet with light; we are powered by its life force and sustained by the plant life which harvests its radiant energy into molecules of health-laden nourishment. May our minds also be enlightened to discern the master plan we are choosing inherent in every spoonful of food which passes our lips, and may it be that at each meal you will find a welcome opportunity to prepare a luscious, salubrious feast for mind, body, heart, and soul.

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***151** Ibid.,p.57.
***152** Ibid., p. 58.
***153** Ibid., p. 191.